



FY-3E/HIRAS-II post launch instrument status and data accuracy analysis



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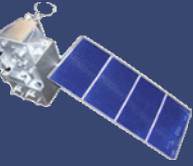
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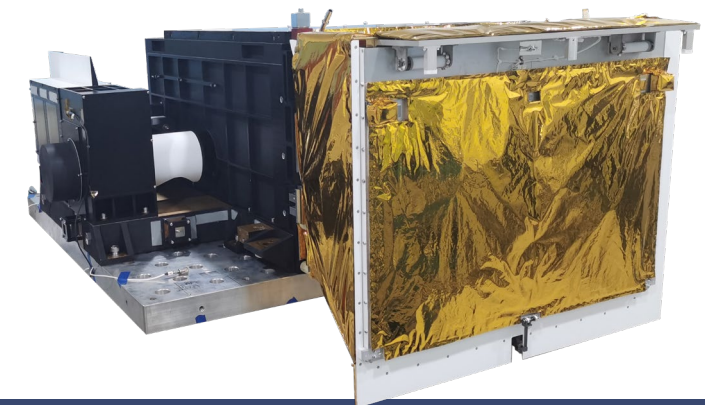
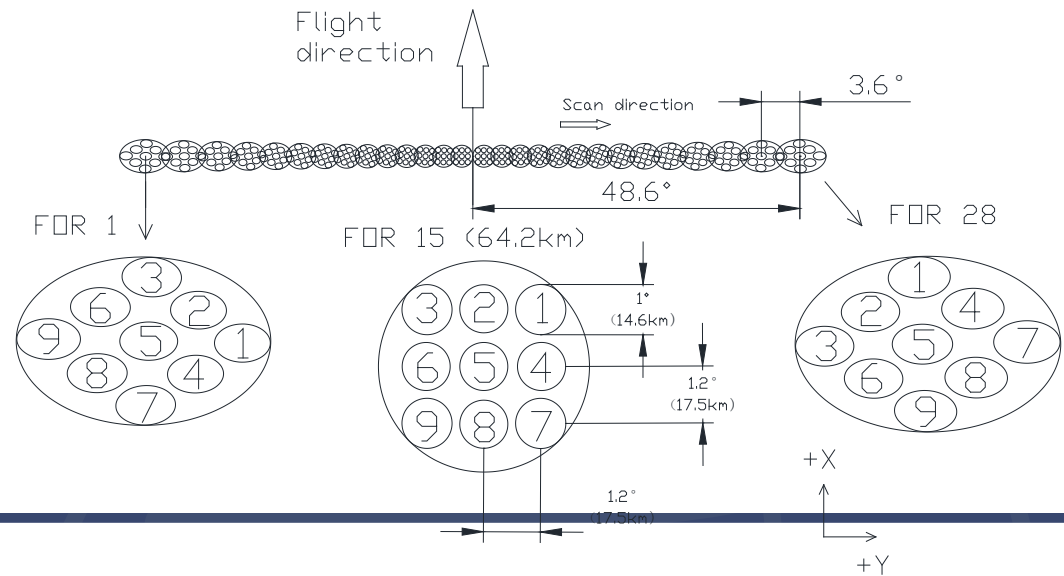
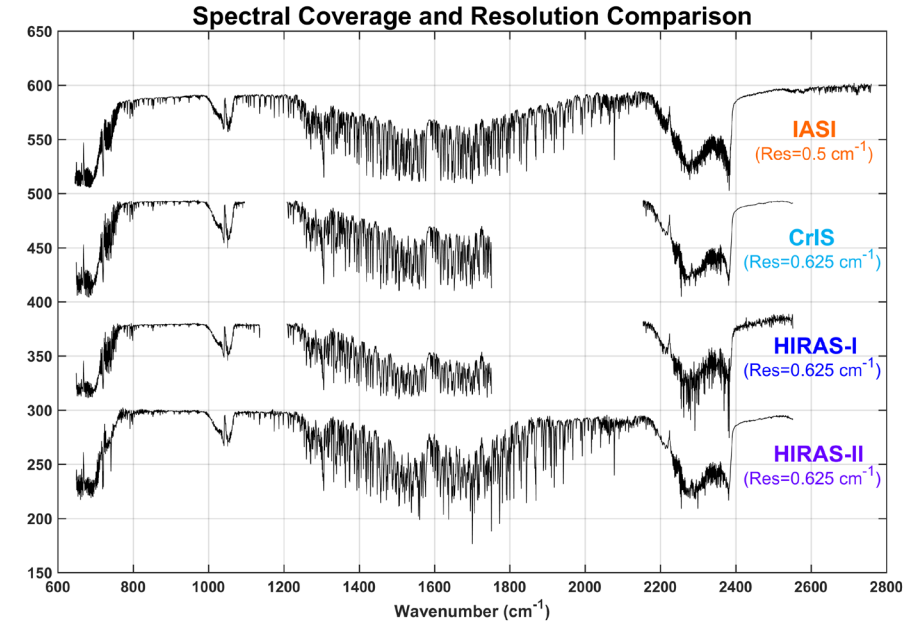
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1.Introducton of FY-3E/HIRAS-II

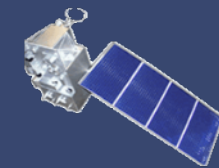


Parameters	Specification(FY-3D)	Specification(FY-3E/F/H)
Scan angle	± 50.4 Deg	± 50.4 Deg
Pixels per scan line	29*4	28*9
view angle	1.1 Deg	1 Deg
Nadir spatial resolution	16 Km	14 Km
Scan period	10 s	8 s
Detectors arrangement	2 × 2	3 × 3
Pointing precision	0.1 Deg	0.06 Deg
Pointing stability	/	0.45 Mrad





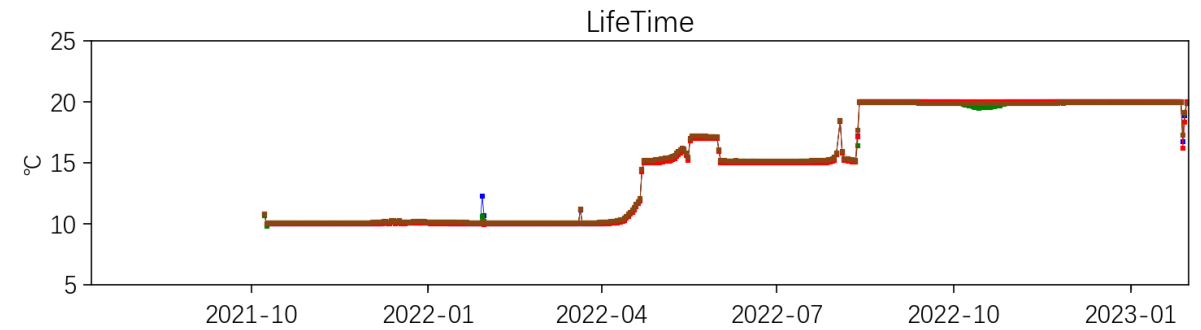
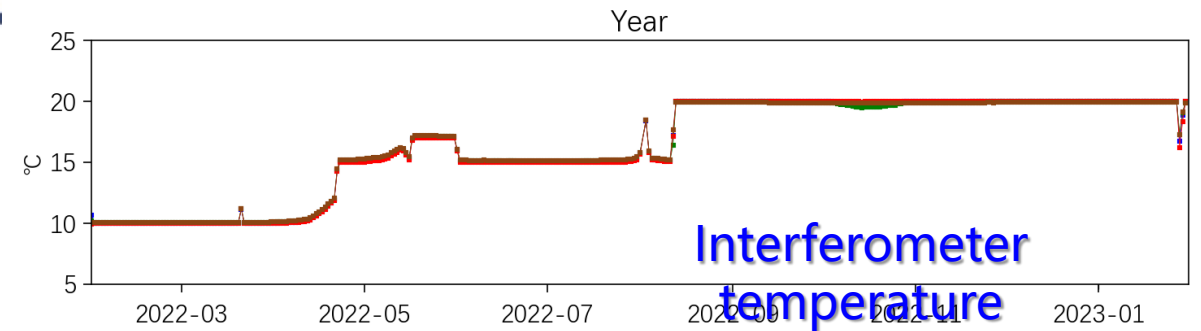
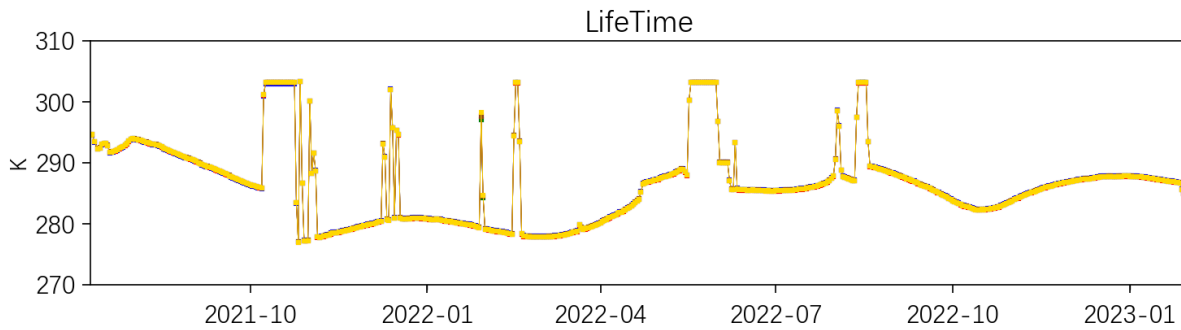
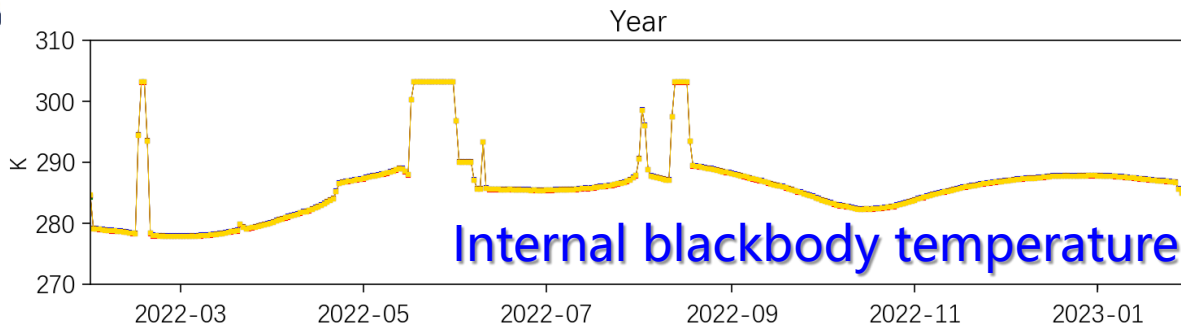
1.Introduction of FY-3E/HIRAS-II



band	Spectral range(cm ⁻¹)	Radiometric Calibration accuracy (K) min requirement /Expectations		Spectral Calibration accuracy (ppm) min requirement /Expectations	
		FY-3D	FY-3E/F/H	FY-3D	FY-3E/F/H
LW	650 ~ 667 cm ⁻¹	1K/0.7K	1K/0.8K	10 ppm	7 ppm /5 ppm
	667~ 689 cm ⁻¹		0.5K/0.4K		
	689~ 1000 cm ⁻¹		0.4K/0.3K		
	1000~ 1136 cm ⁻¹		0.5K/0.4K		
MW	1210~ 1538 cm ⁻¹	1K/0.7K	0.4K/0.3K		
	1538~ 1750 cm ⁻¹		0.5K/0.4K		
SW	2155~ 2300 cm ⁻¹	1K/0.7K	0.5K/0.4K		
	2300~ 2550 cm ⁻¹		0.6K/0.5K		



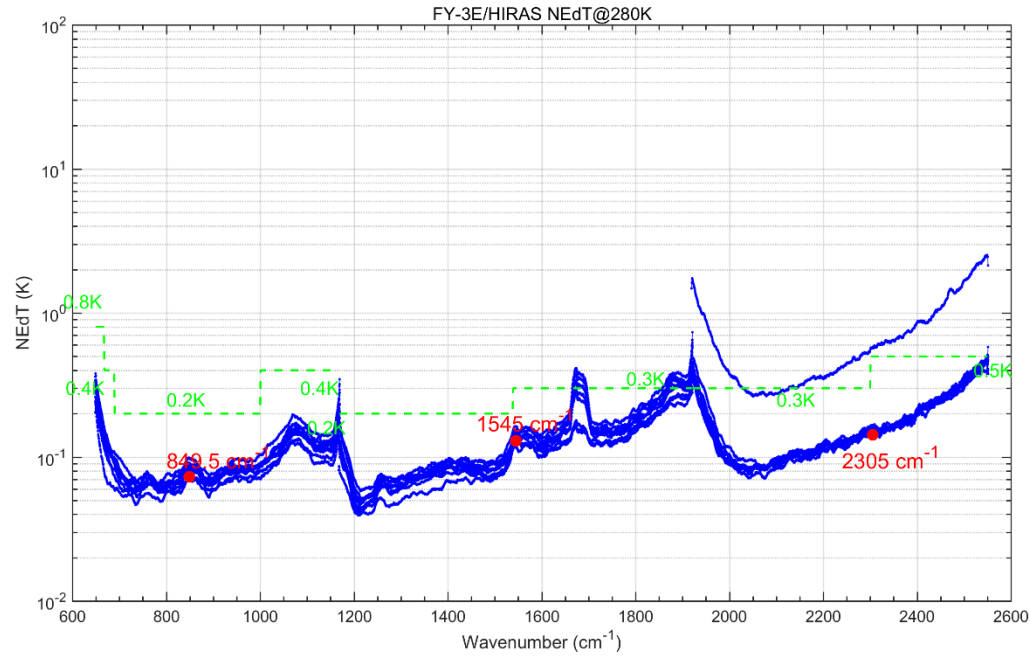
2. Post launch instrument status



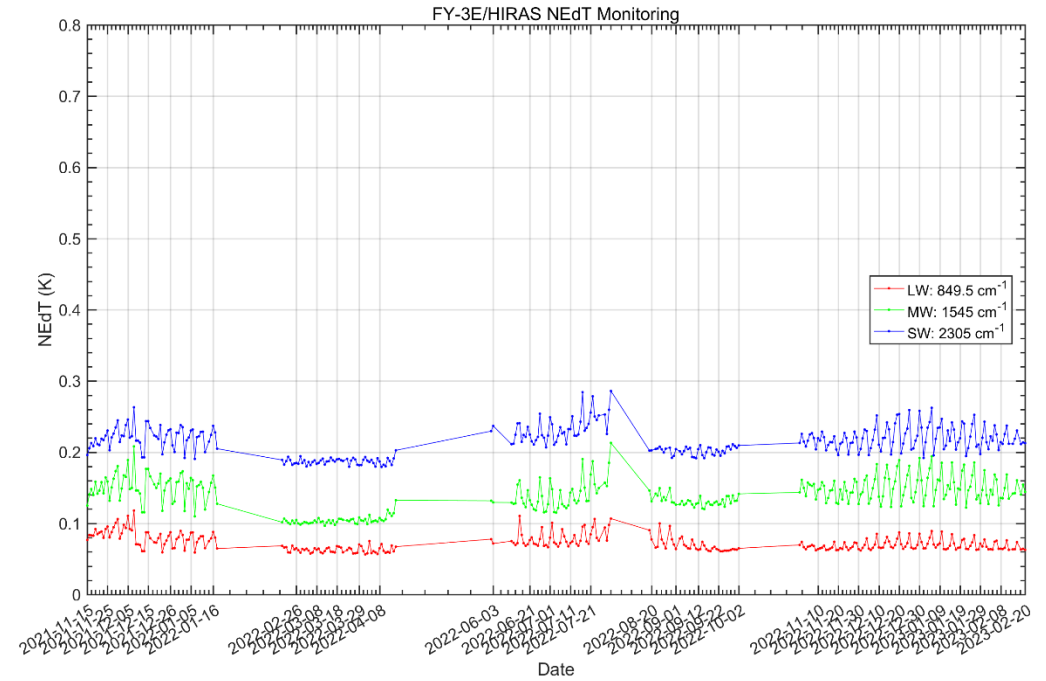
- FY-3E satellite launched on 5 Jul, 2021, orbiting in a 5:30 AM/PM polar orbit.
- Instrument temperature fluctuations due to the sunlight from low solar elevation angles.
- Interferometer temperature set at 20 Celsius degrees on August 18, 2022.
- The parameters for spectral/radiometric calibration, such as off-axis correction and nonlinear correction coefficients, were also adjusted along with the temperature field.



2.Noise performance and instrument responsivity



HIRAS-II nine FOVs NEdT@280K BB

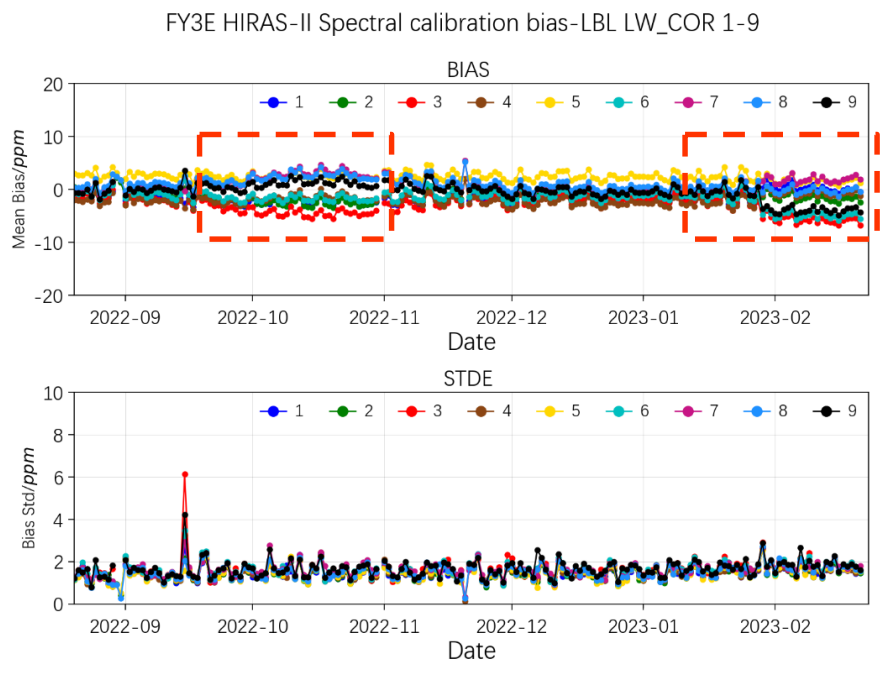
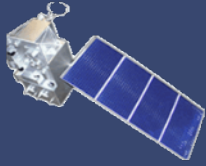


Channel NEdT monitoring

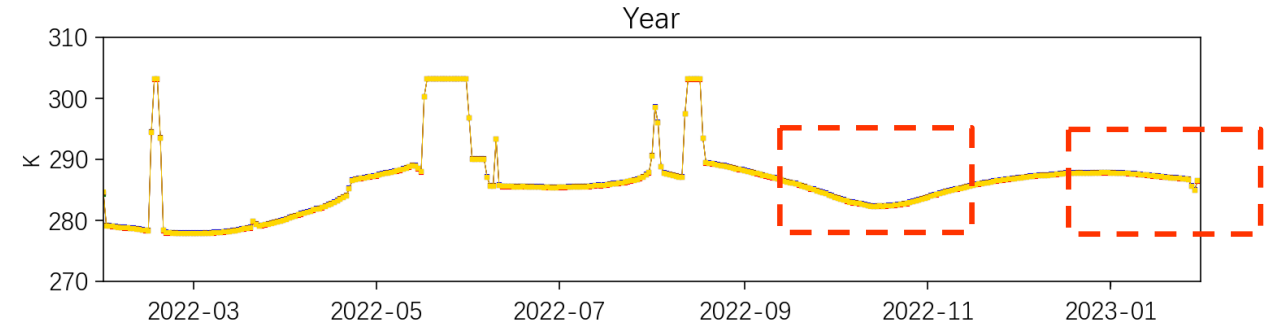
HIRAS-II meets the noise specification in all fields of view (FOV) except FOV-1 in SWIR band, and the NEdT trends are stable, even though the instrument basic temperature field was changed in August 2022.



3. Data accuracy evaluation



From August 2022 to February 2023.



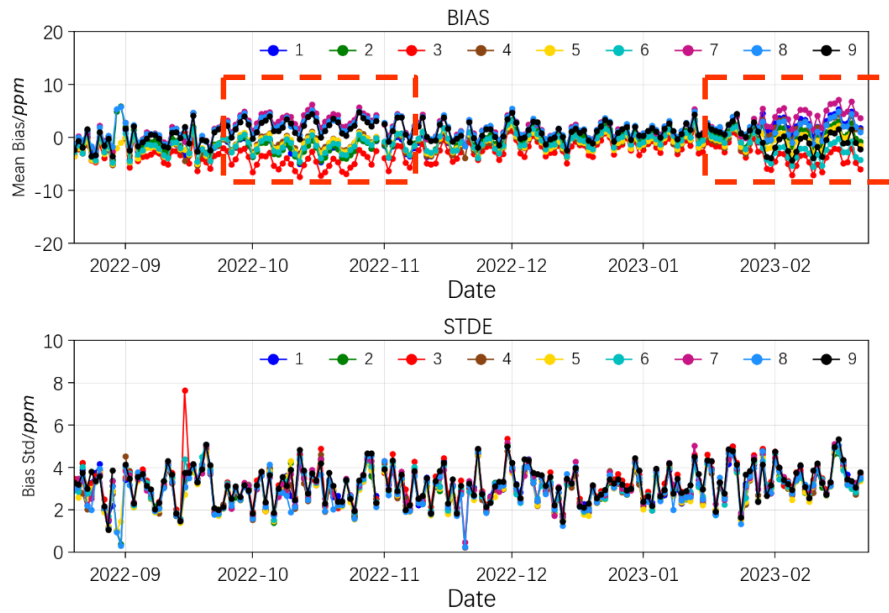
- The relative spectral offsets with respect to LBLRTM simulated spectra for three bands are less than 5 ppm in average.
- The offsets seem increase along with the sounder seasonal temperature decrease in October 2022 and February 2023.
- The longer trending after the sounder temperature field reset need to be traced for a whole year at least.



3. Data accuracy evaluation

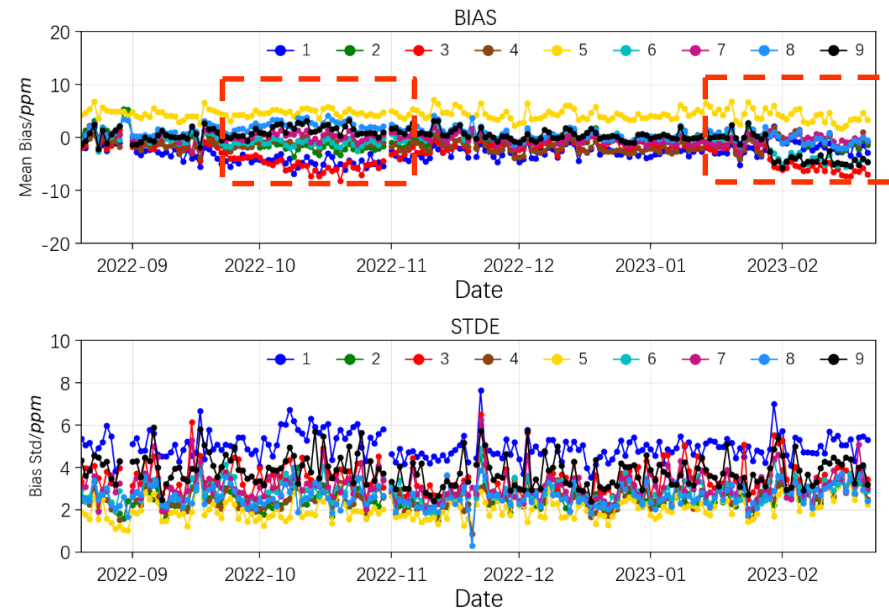


FY3E HIRAS-II Spectral calibration bias-LBL MW_COR 1-9



From August 2022 to February 2023.

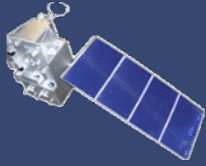
FY3E HIRAS-II Spectral calibration bias-LBL SW_COR 1-9



The similar trends in MWIR and SWIR bands.



Inter-comparisons of FY-3E/HIRAS-II and MetOp/IASI



SNO Criteria:

Time difference: ≤ 900 s

Pixel distance: 6 km

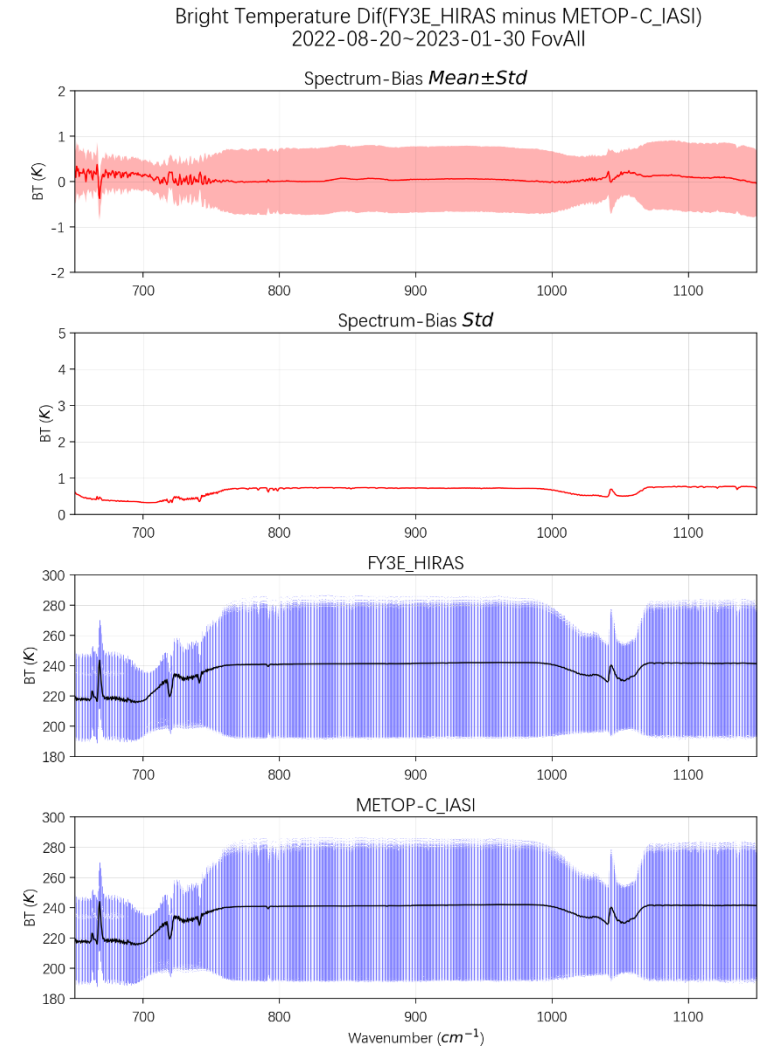
Zenith angle difference: $abs[\cos(\text{zenith1})/\cos(\text{zenith2}) - 1] \leq 0.01$

FOV homogeneity: $\text{stddev}(\text{MERSI})/\text{mean}(\text{MERSI}) < 0.01$

The radiometric uncertainty is mainly assessed through HIRAS-IASI SNOs in the last year.

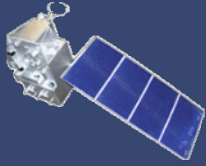
The HIRAS-IASI BT difference in LWIR band is about 0.2 K (std. dev. ~ 1 K).

Hamming apodization, Conversion to BT at scene radiance

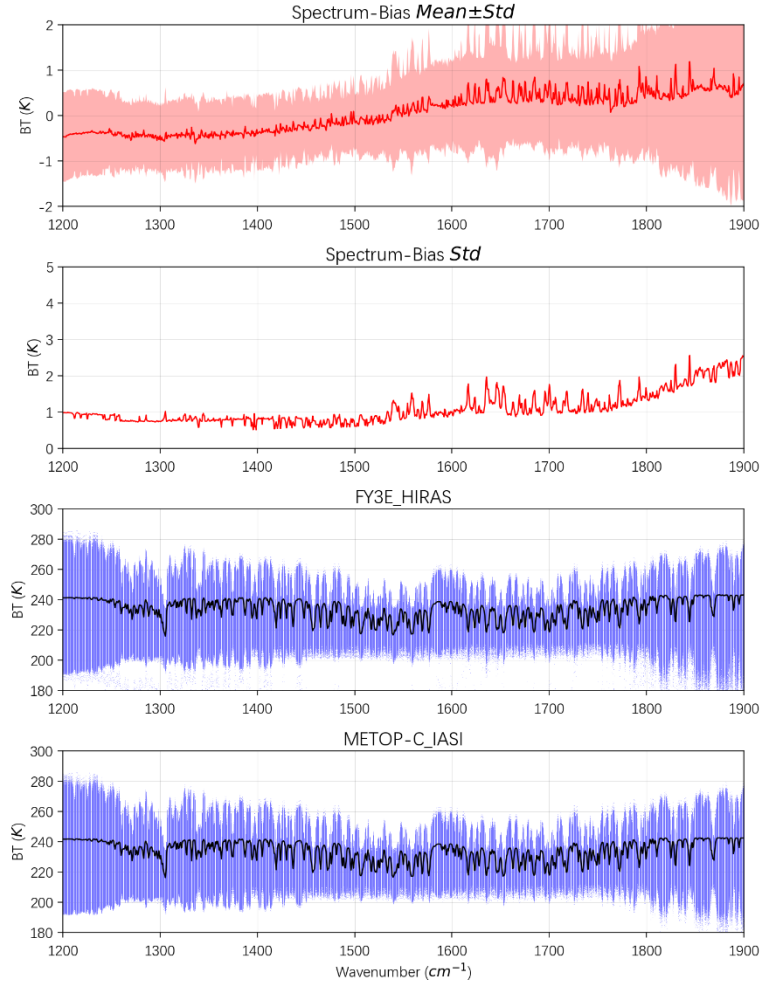




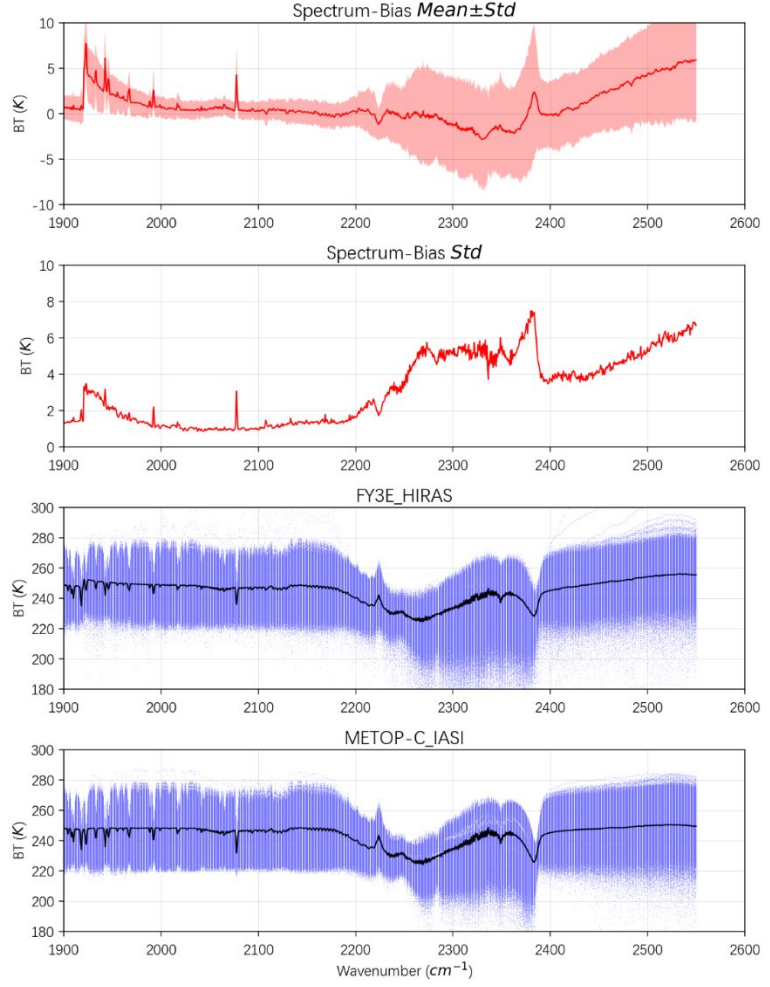
Inter-comparisons of FY-3E/HIRAS-II and MetOp/IASI



Bright Temperature Dif(FY3E_HIRAS minus METOP-C_IASI)
2022-08-20~2023-01-30 FovAll

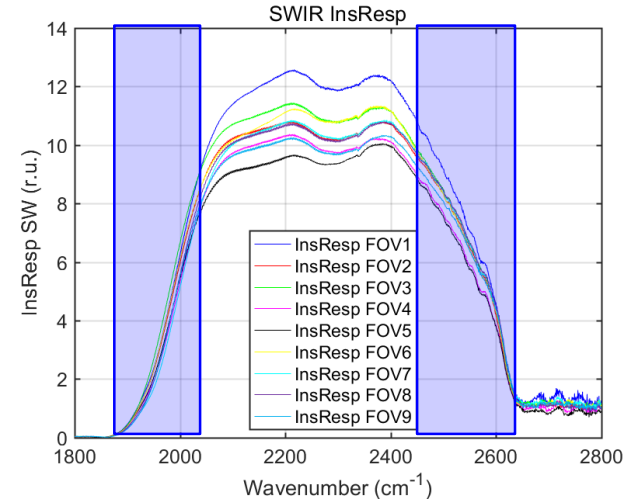


Bright Temperature Dif(FY3E_HIRAS minus METOP-C_IASI)
2022-08-20~2023-01-30 FovAll



The HIRAS-IASI BT difference in MWIR band varies from 0.5 K to 1 K (std. dev. 1~2 K).

In SWIR band, the difference is more than 2 K in both sides of instrument responsivity roll-off range.



Hamming apodization, Conversion to BT at scene radiance



3. Data accuracy evaluation



Diagram of Bright Temperature (HIRAS-IASI)
FY3E_HIRAS IASI LW_800cm-1

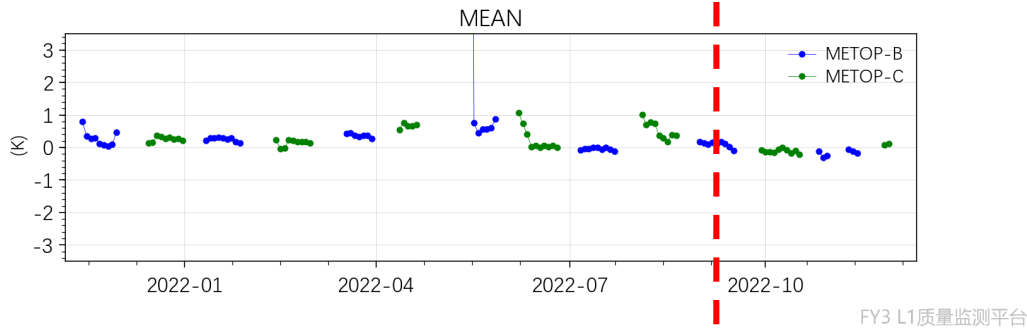


Diagram of Bright Temperature (HIRAS-IASI)
FY3E_HIRAS IASI MW1_1500cm-1

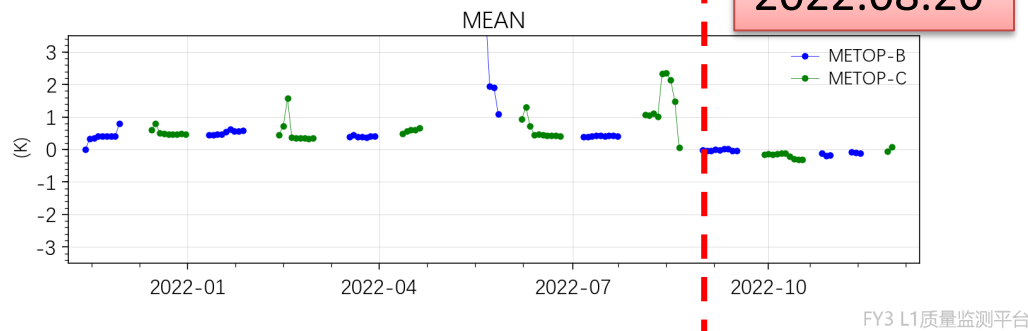
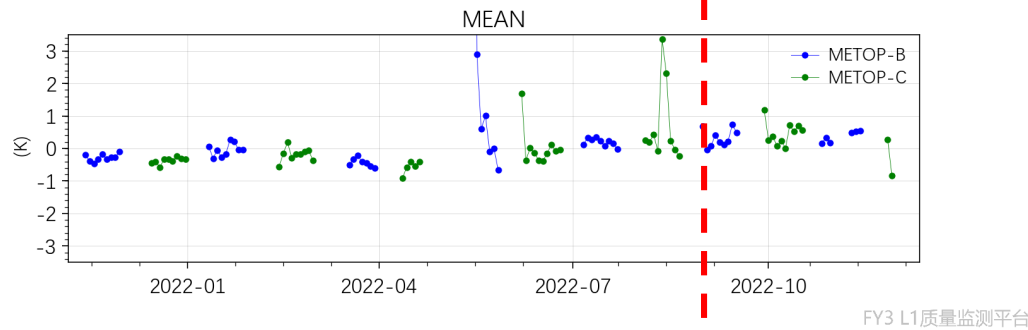


Diagram of Bright Temperature (HIRAS-IASI)
FY3E_HIRAS IASI MW2_2400cm-1



- HIRAS-II set up stable instrument status on 20 Aug, 2022.
- FY-3E/HIRAS-II radiometric accuracy mean bias in LWIR and most MWIR channels less than **0.5K**, window and weak absorptive channels in SWIR less than **0.5K**;
- Set up HIRAS vs IASI calibration monitoring system, BT bias VS IASI keep stable. More quality control need to be added that related with instrument status when in orbit test phase.



4. Conclusion



- Due to the sunlight on 0530 orbit, the instrument temperature field of FY-3E/HIRAS-II was reset in August 2022, and the parameters for calibration were adjusted to fit the new state of the sounder.
- The noise and instrument responsivity of HIRAS-II were stable for 1.5 years after launch.
- The spectral calibration with respect to LBLRTM is in range of 5 ppm for three bands respectively, but it seems to be affected by the seasonal fluctuations of the sounder internal temperature.
- The radiometric calibration with respect to MetOp-B/C IASI is about 0.2 K in LWIR, 0.5 to 1 K in MWIR.
- The 3rd HIRAS will be launched in the Aug, 2023 onboard FY-3F satellite.



Thanks for your attention

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