

## Introduction of FY4B GIIRS and its application prospect



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### INTRODUCTION

GIIRS is the precise instrument which is carried in Geostationary orbit to measure the vertical profile of temperature and humidity of the atmosphere with improved detection accuracy and vertical resolution. FY-4B GIIRS is the operational satellite and have been launched successfully on June 3<sup>rd</sup>, 2021.

### Performance

It includes two infrared bands with the  $0.625 \text{ cm}^{-1}$  spectral resolution and one VIS band, respectively LWIR ( $680\text{-}1130\text{cm}^{-1}$ ), S/MIR ( $1650\text{-}2250 \text{ cm}^{-1}$ ), and VIS ( $0.55\text{-}0.75 \mu\text{m}$ ). Compared with FY-4A GIIRS, the focal array for FY-4B GIIRS is arranged with  $16 \times 8$ . The sensitivity is improved significantly, such as less than  $0.5 \text{ mW/m}^2 \text{ sr m}^{-1}$  for LWIR, and less than  $0.1 \text{ mW/m}^2 \text{ sr m}^{-1}$  for MWIR. In the same time, the radiation calibration accuracy improves from 1.5K to 0.7K, and the spectral calibration accuracy improves from 10ppm to less than 10ppm. Besides, the spatial resolution is improved from 16 km to 12 km for infrared bands and from 2 km to 1 km for VIS.

Sensor		FY-4A	FY-4B
GIIRS	Spectral Range	LWIR: $700\text{cm}^{-1}\text{-}1130\text{cm}^{-1}$ S/MIR: $1650\text{cm}^{-1}\text{-}2250\text{cm}^{-1}$ VIS: $0.55\text{-}0.75\mu\text{m}$	LWIR: $680 \text{ cm}^{-1}\text{-}1130 \text{ cm}^{-1}$ S/MIR: $1650 \text{ cm}^{-1}\text{-}2250 \text{ cm}^{-1}$ VIS: $0.55\text{-}0.75\mu\text{m}$
	Spectral Resolution (Normal mode)	LWIR: $0.625\text{cm}^{-1}$ S/MIR: $0.625\text{cm}^{-1}$	LWIR: $0.625\text{cm}^{-1}$ S/MIR: $0.625\text{cm}^{-1}$
	Operational Mode	$1000 \times 1000 \text{ km}^2$ $5000 \times 5000 \text{ km}^2$	$5000 \times 5000 \text{ km}^2$
	Temporal Resolution	China area: $<1\text{hr}$ Mesoscale area: $<0.5\text{hour}$	China area: $<45\text{min}$
	Sensitivity ( $\text{mW/m}^2\text{sr cm}^{-1}$ )/S/N	LWIR: $0.5\text{-}1.1$ S/MIR: $0.1\text{-}0.14$ $S/N \geq 200$ ( $\rho = 100\%$ )	LWIR: $\leq 0.5$ S/MIR: $\leq 0.1$ $S/N \geq 200$ ( $\rho = 100\%$ )
	Calibration accuracy (radiation)	1.5K	0.7K
	Calibration accuracy (spectrum)	10ppm ( $3\sigma$ )	$<10\text{ppm}$ ( $3\sigma$ )
	Spatial Resolution	L/S/MIR: 16km VIS: 2km	L/S/MIR: 12km VIS: 1km

### TVAC-spectral calibration

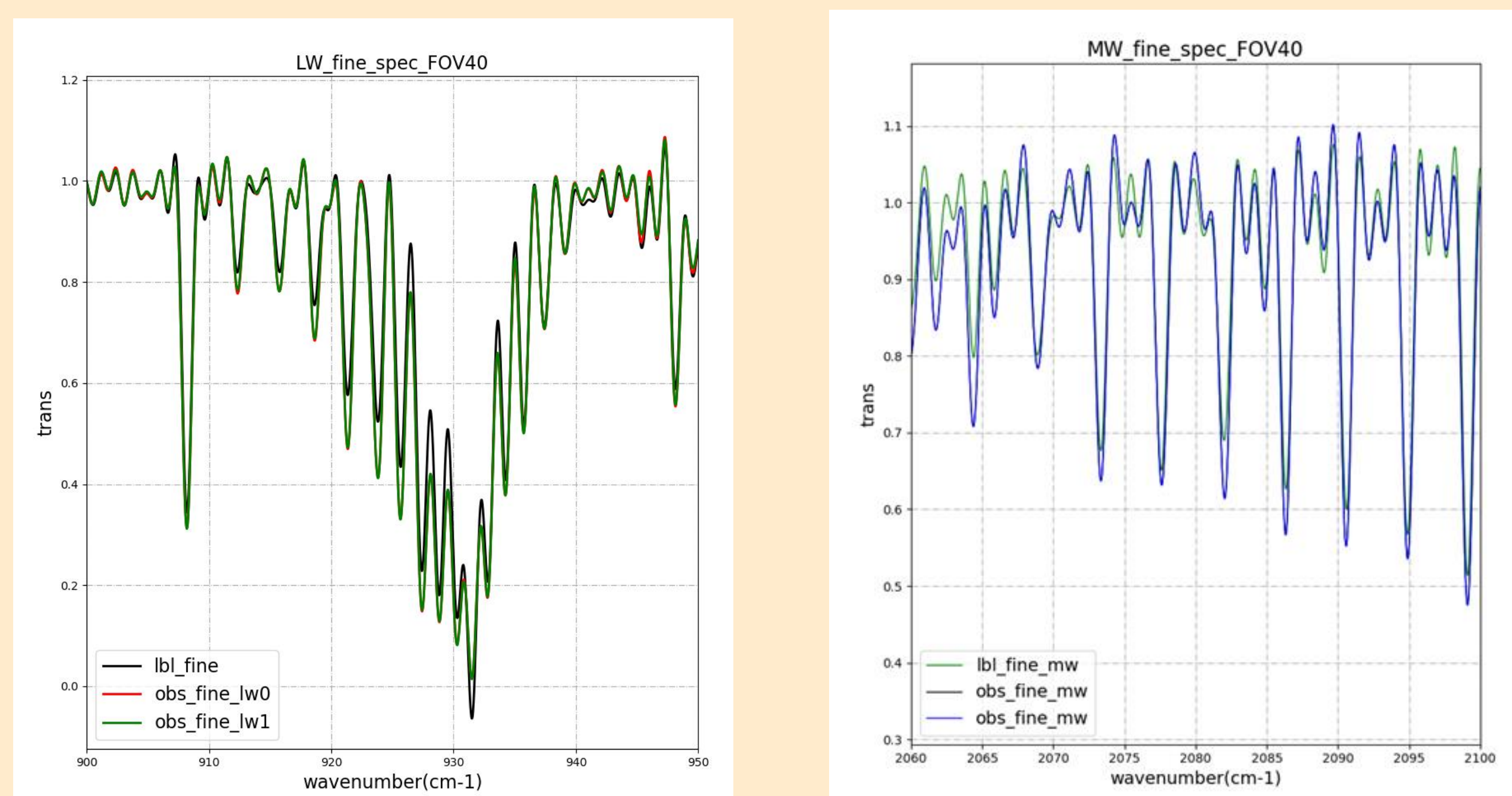


Fig. 1 the comparison of fine spectrum between the observation transmittance and LBL transmittance.

The evaluation of fine spectra show that the GIIRS TVAC data satisfies the requirement (better than 10 ppm)

### TVAC-radiation calibration

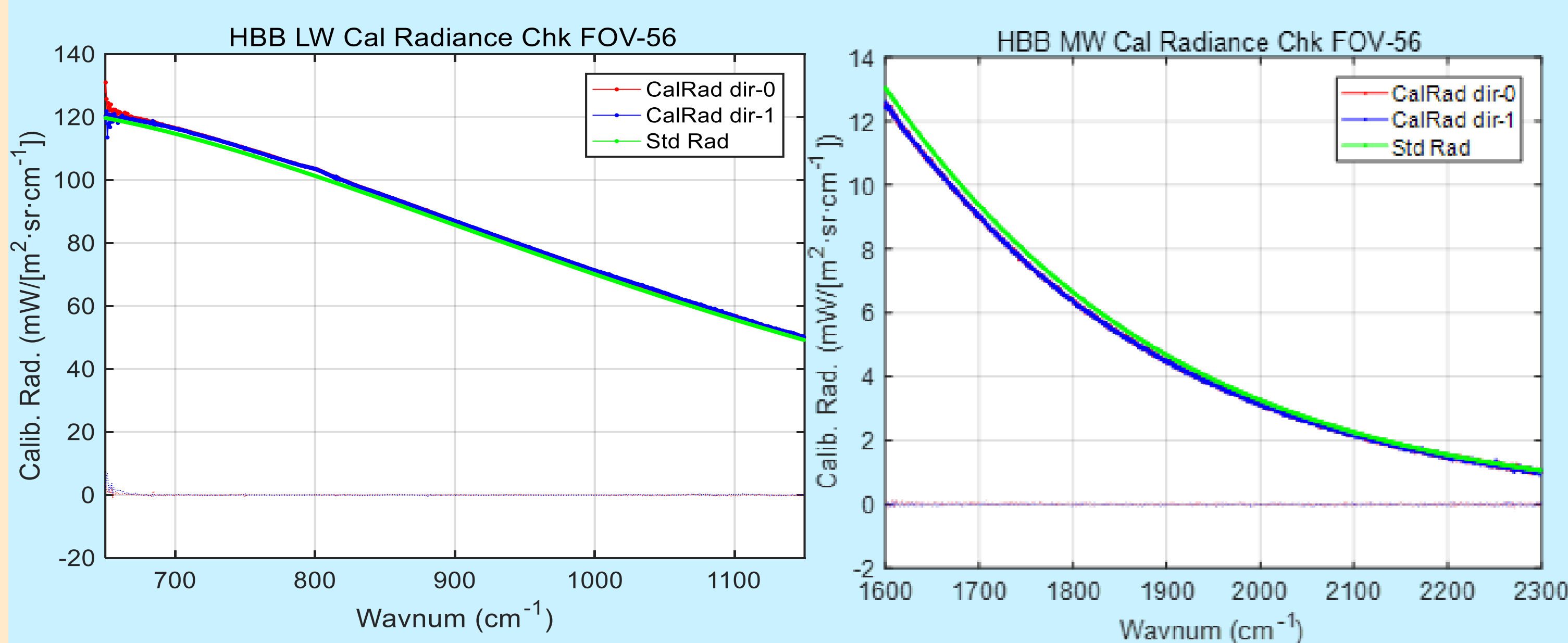


Fig.2 The comparison between the calibration spectrum and theoretical spectrum.

The evaluation of calibration spectra show that the GIIRS TVAC data satisfies the requirement (0.7K)

### CONCLUSION

- Compared with FY 4A/GIIRS, FY 4B/GIIRS improves the spectral calibration, radiation calibration, sensitivity, and spatial resolution, and TVAC results show the instrument meet the requirements, such as spectral calibration ( $<10 \text{ ppm}$ ), radiation calibration ( $0.7\text{K}$ ), sensitivity ( $\leq 0.5 \text{ mW/m}^2 \text{ sr cm}^{-1}$  for LW,  $\leq 0.1 \text{ mW/m}^2 \text{ sr cm}^{-1}$  for MW), and has the better performance.
- GIIRS can provide the rich information about the three-dimensional vertical distribution structure of atmospheric temperature and humidity profile and atmospheric composition (ozone, trace gas), etc. Its observational data and products are mainly used in fields such as numerical weather forecasting, air quality monitoring, climate change monitoring, global radiation energy budget, and atmospheric trace gas changes, etc.