



Monitoring of the GEMS characteristics

M.H. Ahn¹, Mina Kang¹, Mijin Eo¹, Yeeun Lee¹, Kyung-Jung Moon², Dai Ho Ko³, Jhoon Kim⁴,
Dongwon Lee²

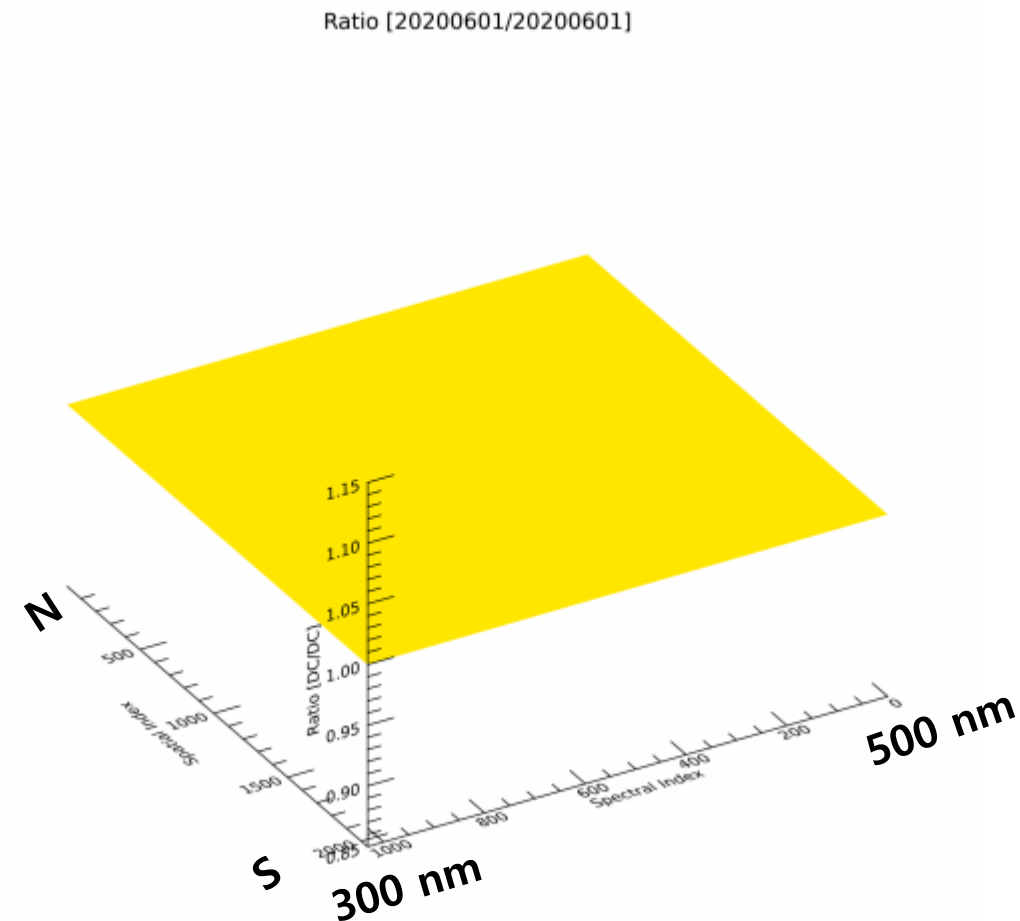
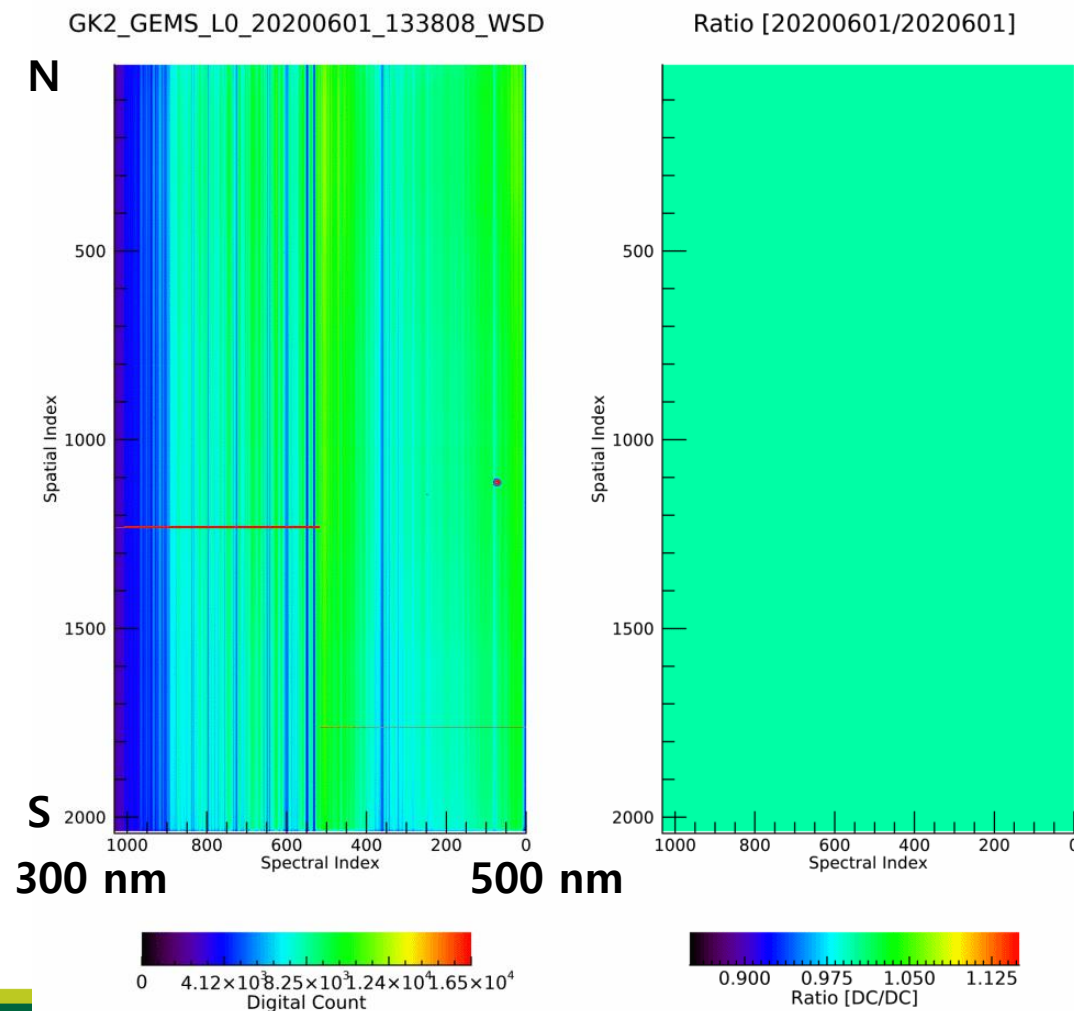
Ewha Womans University¹
National Institute of Environmental Research²
Korea Aerospace Research Institute³
Yonsei University⁴

Contents

- ❖ Any significant trend in the GEMS?
 - L0 digital count and L1 irradiances
 - LED measurement
 - Dark current
 - Bad pixels
 - Telemetries
- ❖ Comparison with imagers onboard GK2-A/B
 - AMI and GOCI-II
- ❖ Summary

L0 Digital Counts

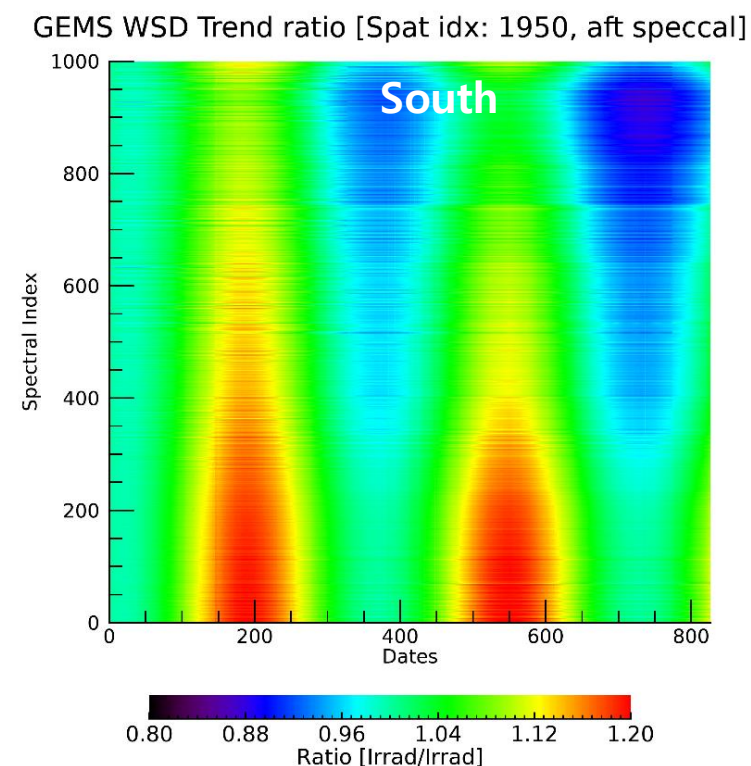
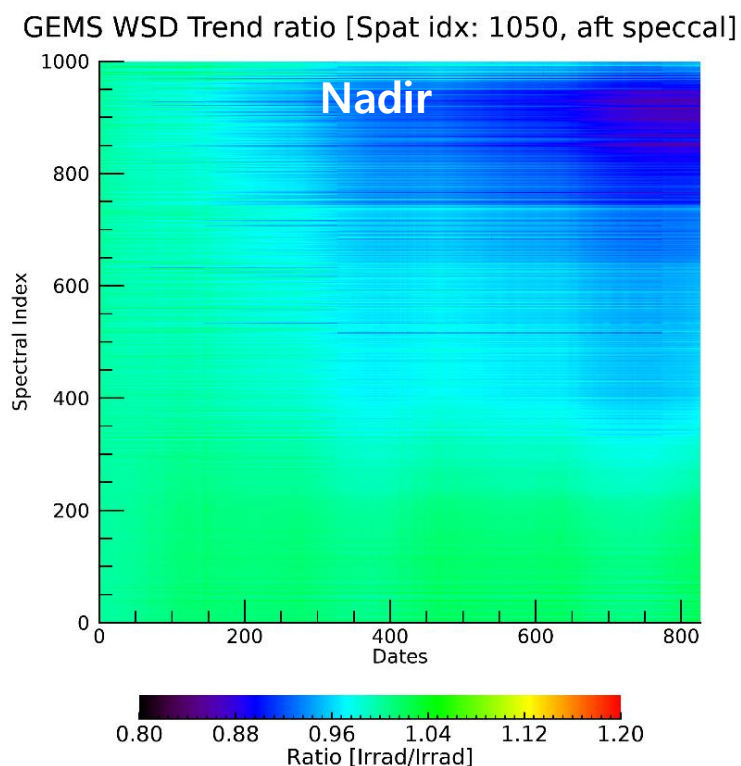
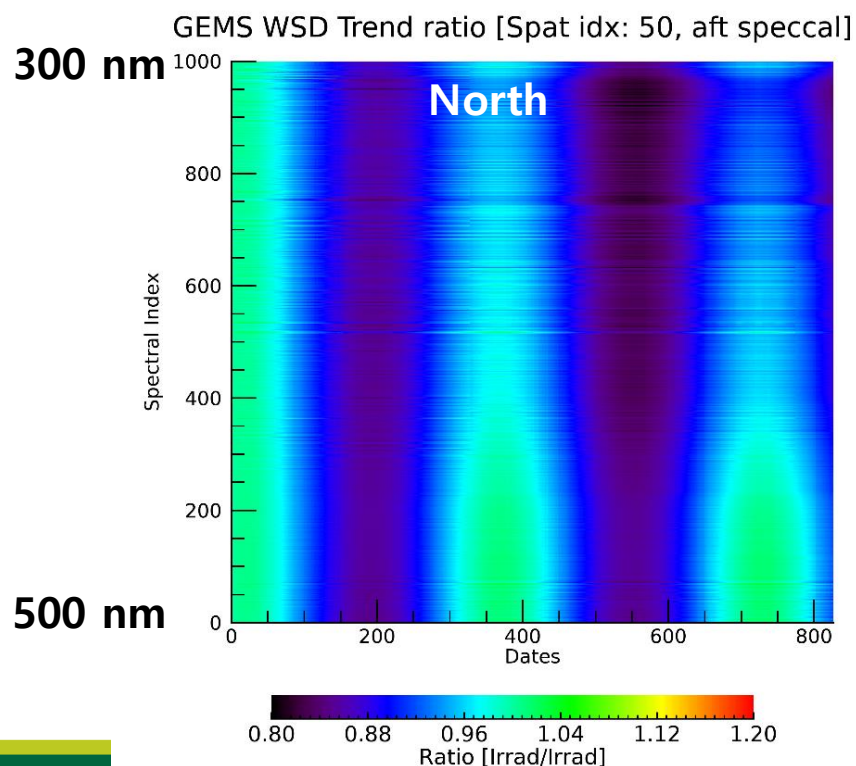
❖ Daily variation of L0 digital counts and ratio



L1 Irradiances

❖ Spatio-spectral variation are there even after radiometric calibration

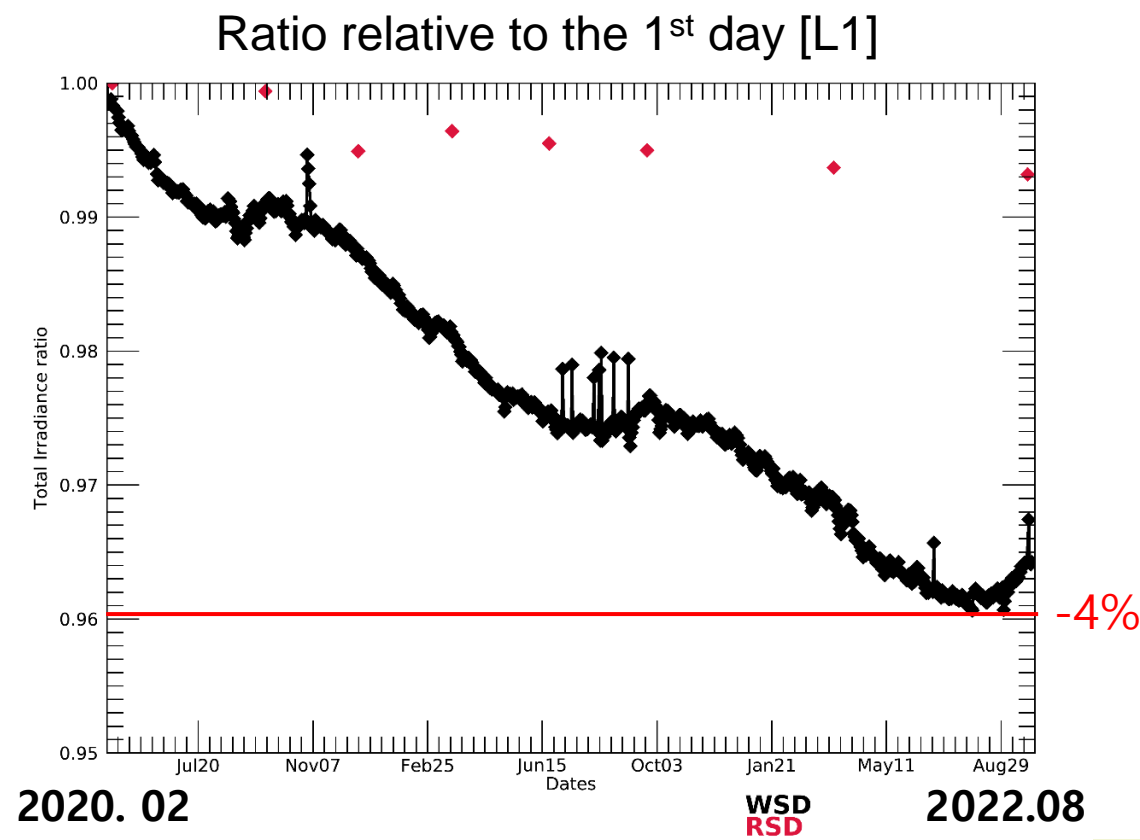
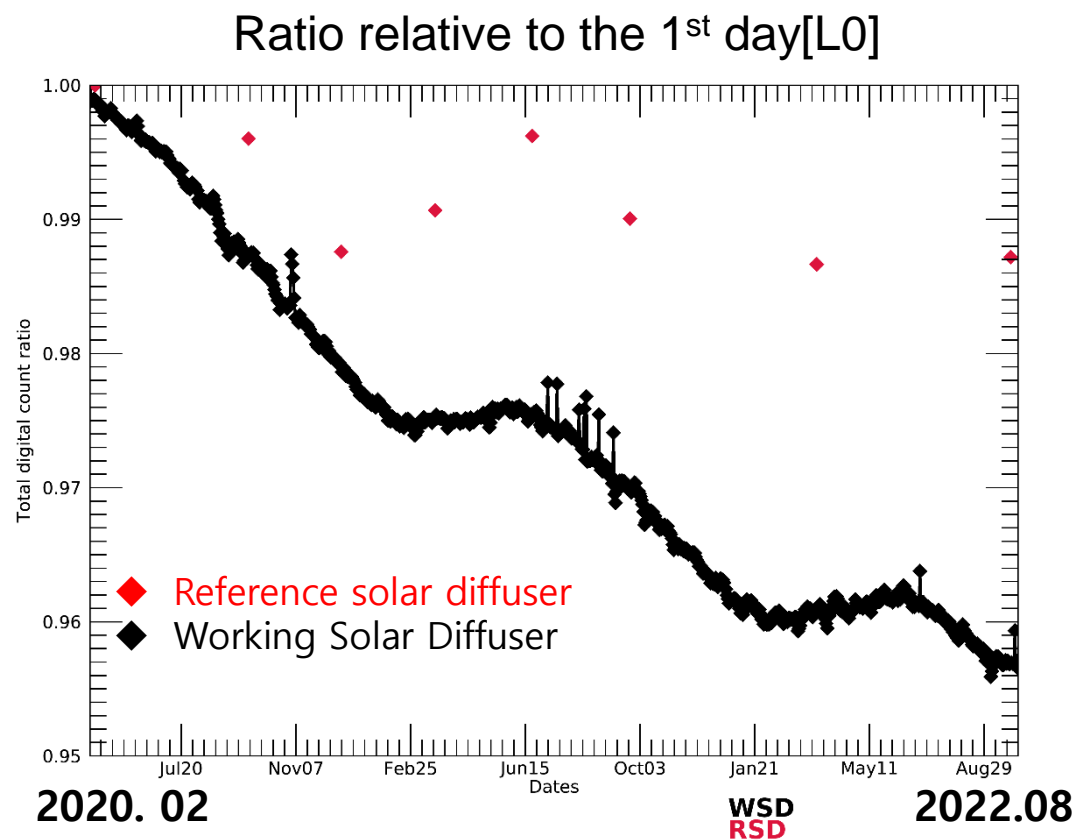
- Minimum variation is shown at nadir position with a significant degradation of irradiances at shorter wavelengths



Trends in L0 and L1

❖ Any trends in the integrated L0 & L1 over all detectors?

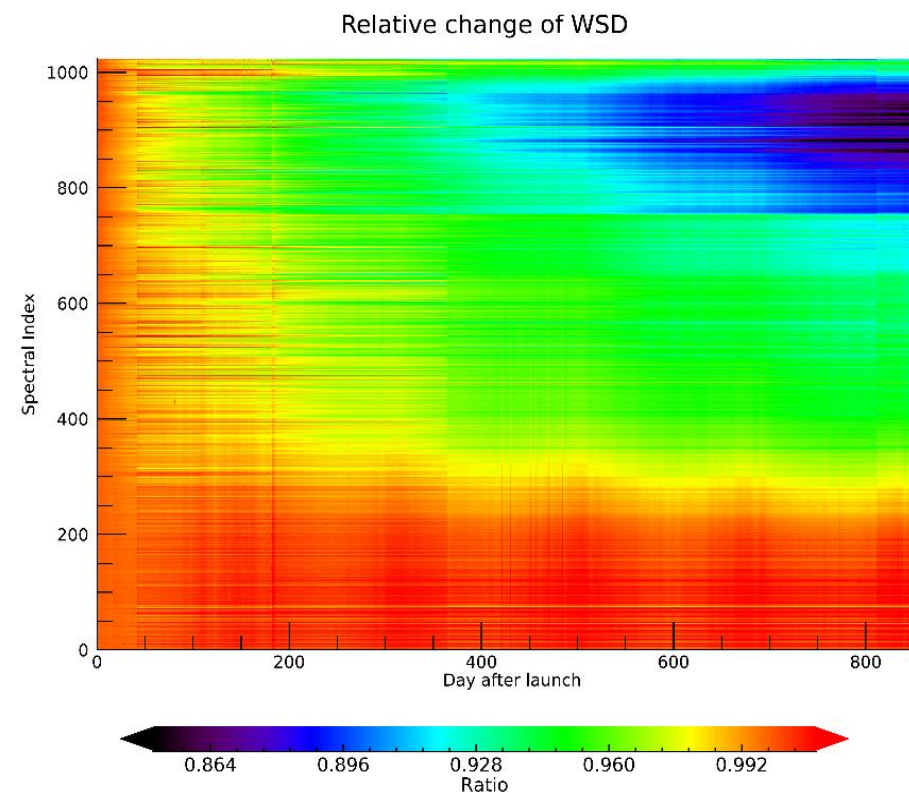
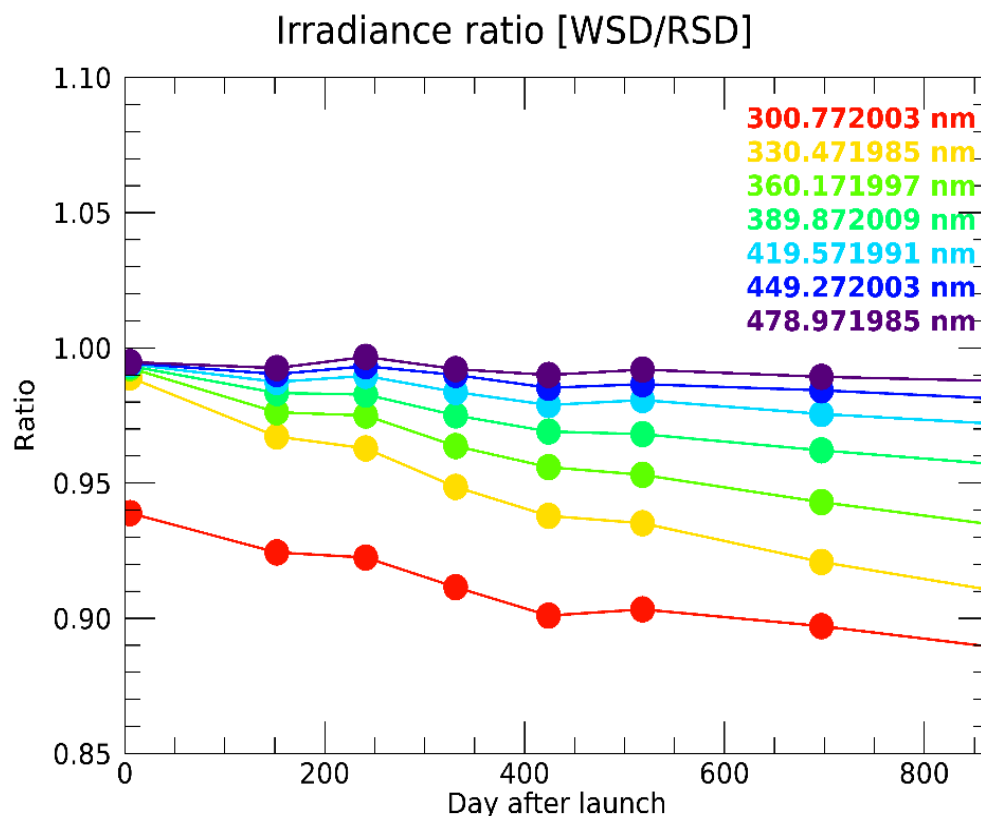
- Decrease of 4.3% and 4% of total digital count and irradiance, respectively



Trends in L1

❖ Shorter wavelengths show the largest degradation

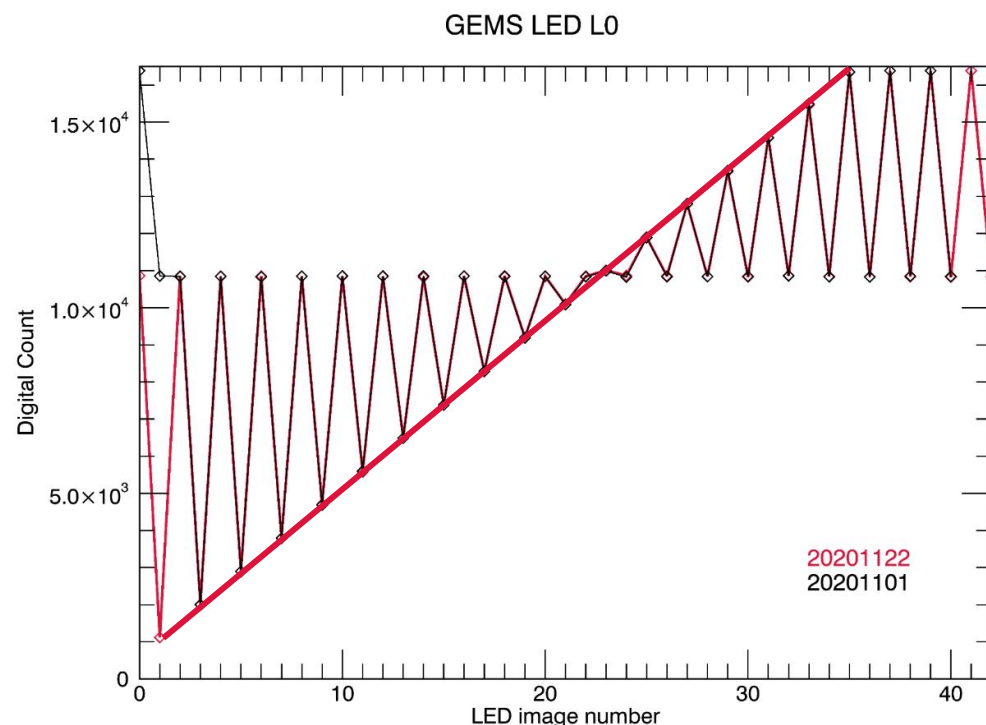
- Compared to the reference solar diffuser, shorter wavelengths show ~ 15% decrease since the operation
- The degradation seems to continue (need a continuous monitoring)



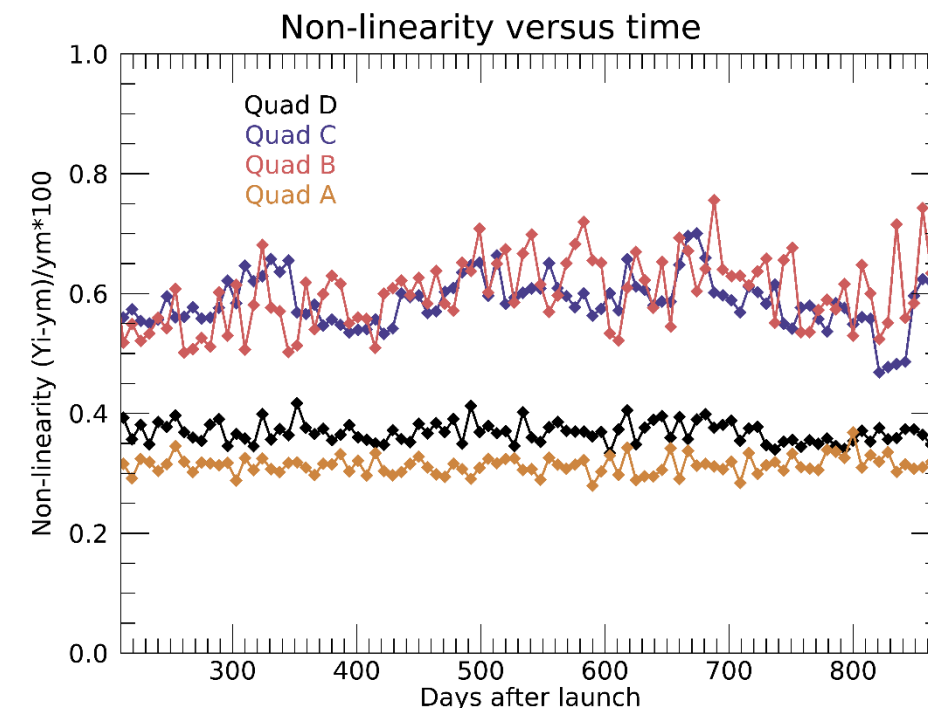
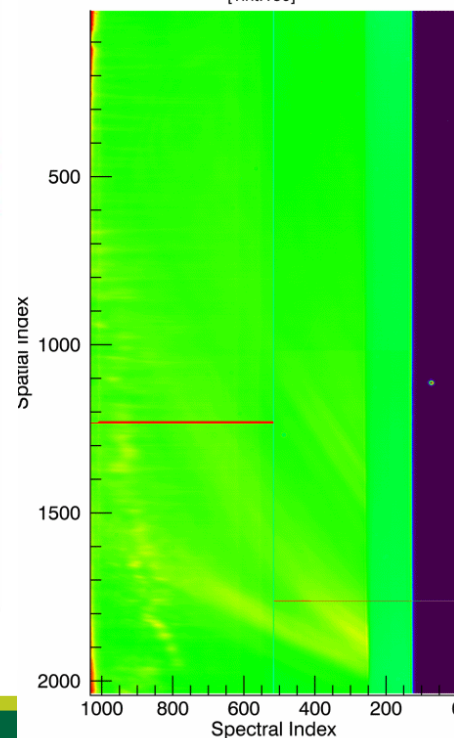
LED measurements

❖ Linearity of CCD is not significantly altered

- Different integration times of LED simulate different input signal
- Increasing trend for the longer exposure time (and vice verse), although the magnitude is smaller than 0.4% for 2-1/2 yrs



GK2_GEMS_L0C_20201122_175004_LED_00
[Tint:130]

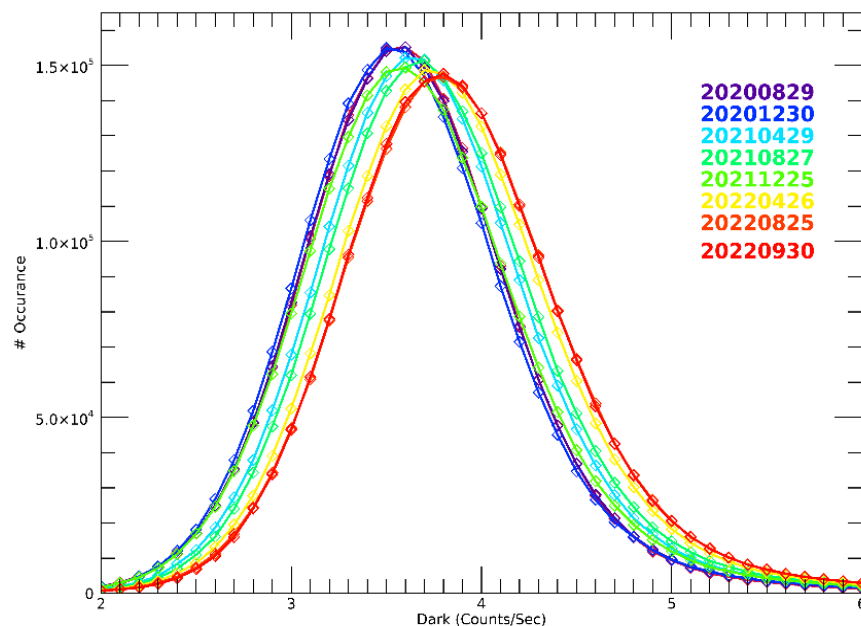


GEMS dark currents

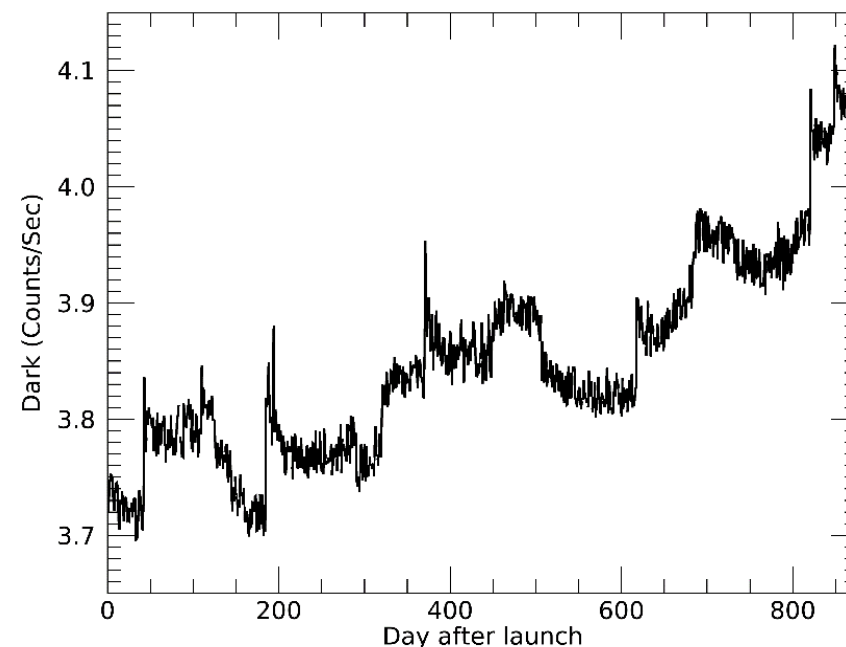
❖ Slow increase of the dark currents

- The frequency distribution shifts toward higher current values
 - ✓ About 5.3% increase in the mean value (over about 3 yrs.)
 - ✓ Averaged dark signals show an increase of 0.01%/day in average

Distribution of dark current



Trend of averaged dark currents



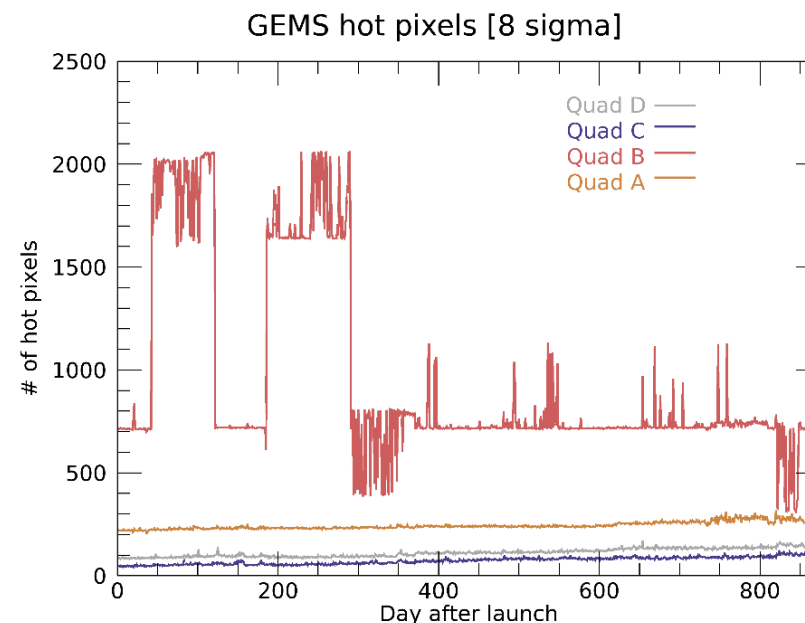
GEMS bad pixels

❖ Slow increase of the hot pixels

- The number of hot pixels* has been increasing slowly
 - ✓ At quadrant A, C, and D, the number show a slow but a steady increase, while in quadrant B, a strong variation is shown (root cause is not yet identified)
 - ✓ The number of cold pixels are not showing any significant variation

GEMS CCD	prelaunch	On-orbit	
	Mean	Mean	STD
Quad A	96.90	72.63	22.32
Quad B	113.99	90.40	68.27
Quad C	102.62	79.12	18.32
Quad D	95.67	70.66	18.75

GEMS CCD averaged dark rate [E-/s]



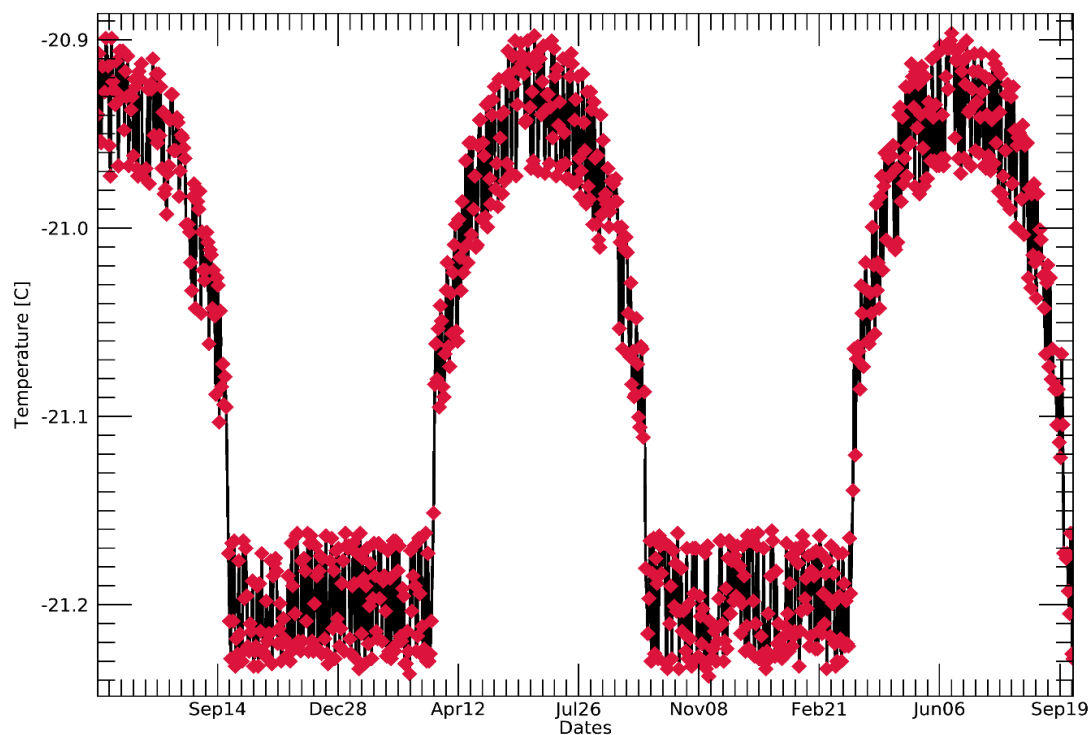
* a pixel having the dark current above the quadrant mean plus 8-sigma (using the initial dark current in orbit)

Trends in telemetries

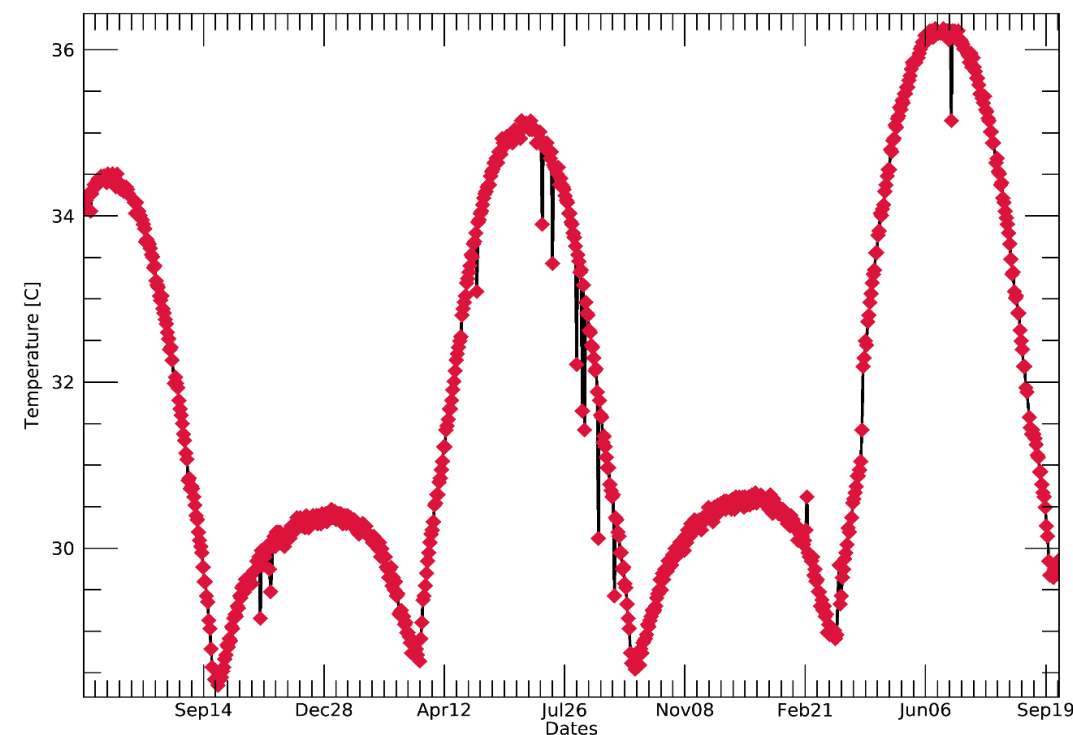
❖ Stable at most telemetries

- CCD temperature varies within about 0.3 K all year long
- The temperature of focal plane electronics (FPE) shows a slight increasing trend although it is under the specification

CCD Temperature [WSD]



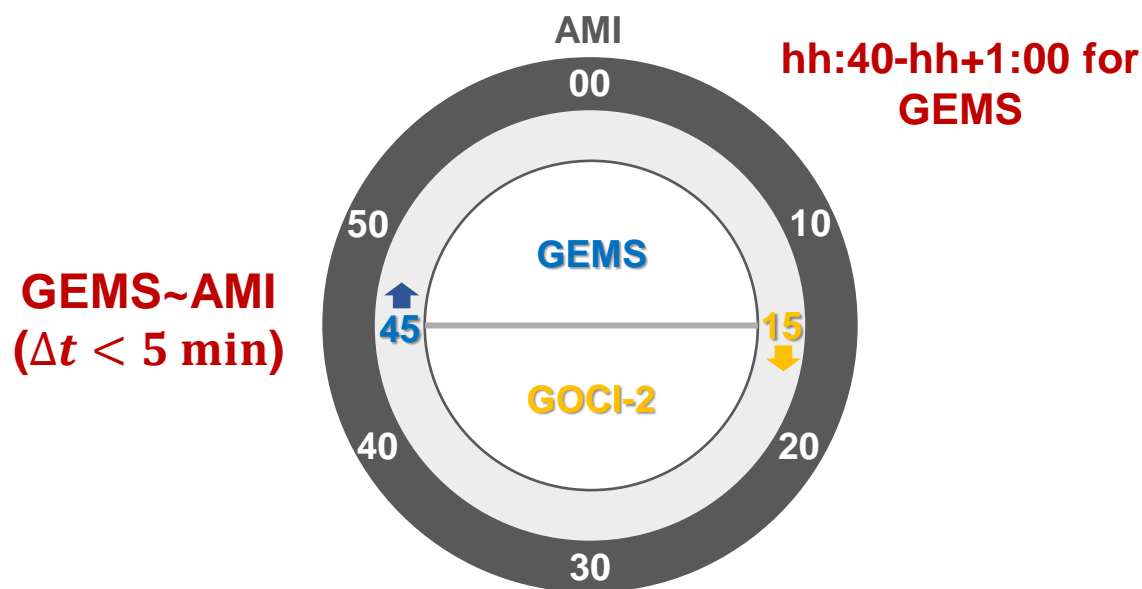
FPE Temperature [WSD]



Inter-comparison with GK-2A/B imagers

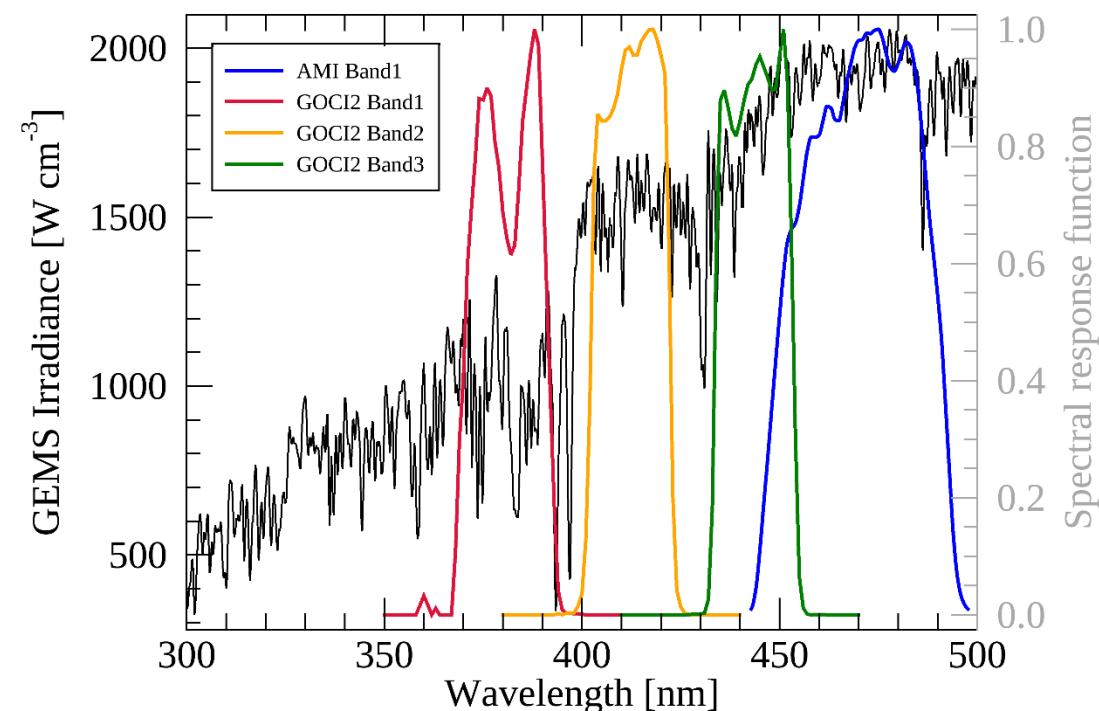
❖ Collocation and spectral matching

- Nov 2020 – Oct 2021, 01-06 UTC (a year long data, 5-days interval)



$$L \otimes f = \frac{\int_{\lambda_i}^{\lambda_f} L_{\lambda} \cdot f_{\lambda} d\lambda}{\int_{\lambda_i}^{\lambda_f} f_{\lambda} d\lambda}$$

$L(\lambda)$: GEMS spectral data
 $f(\lambda)$: AMI Spectral response function

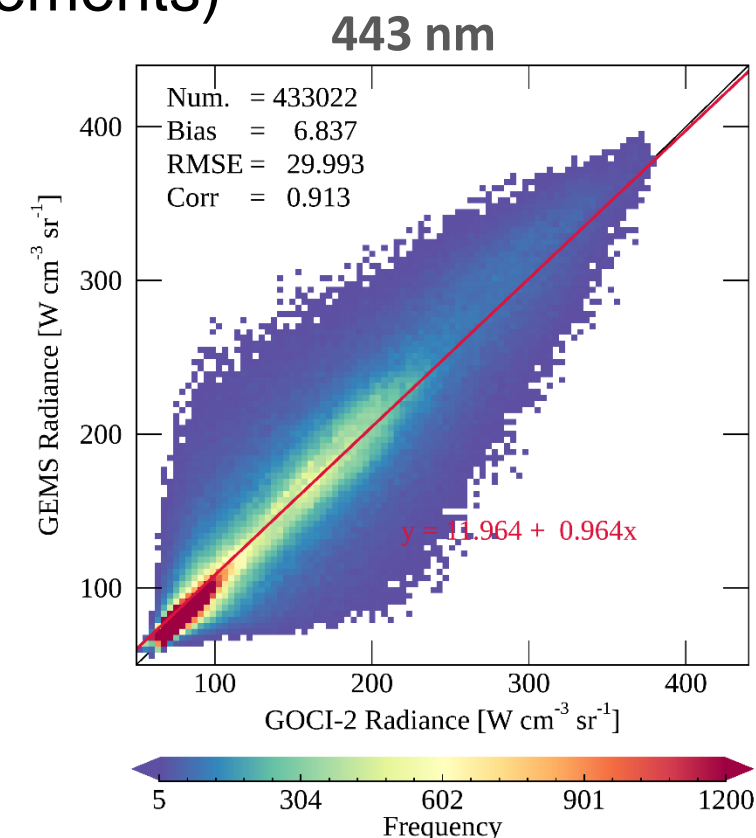
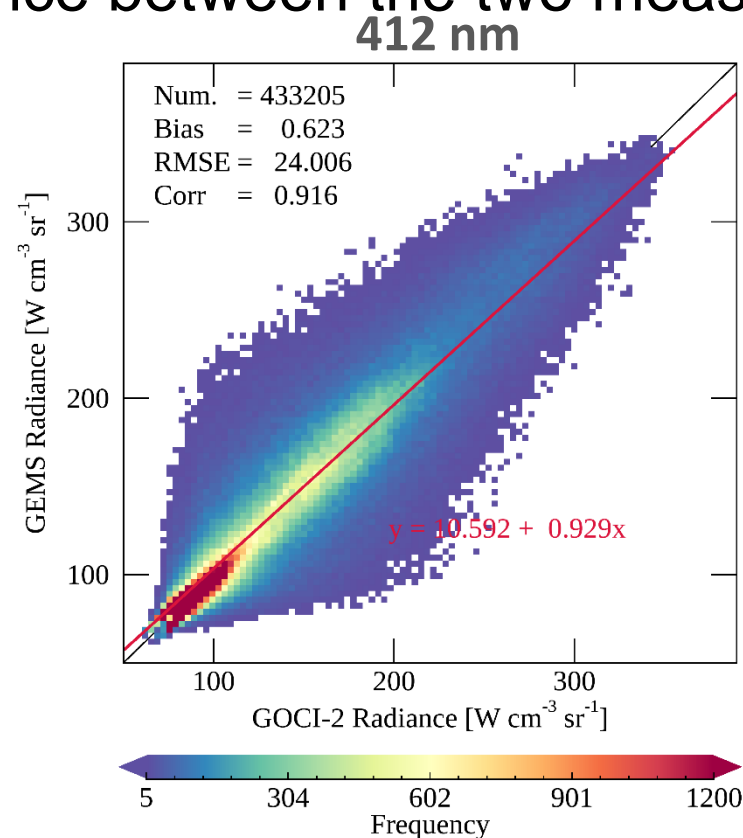
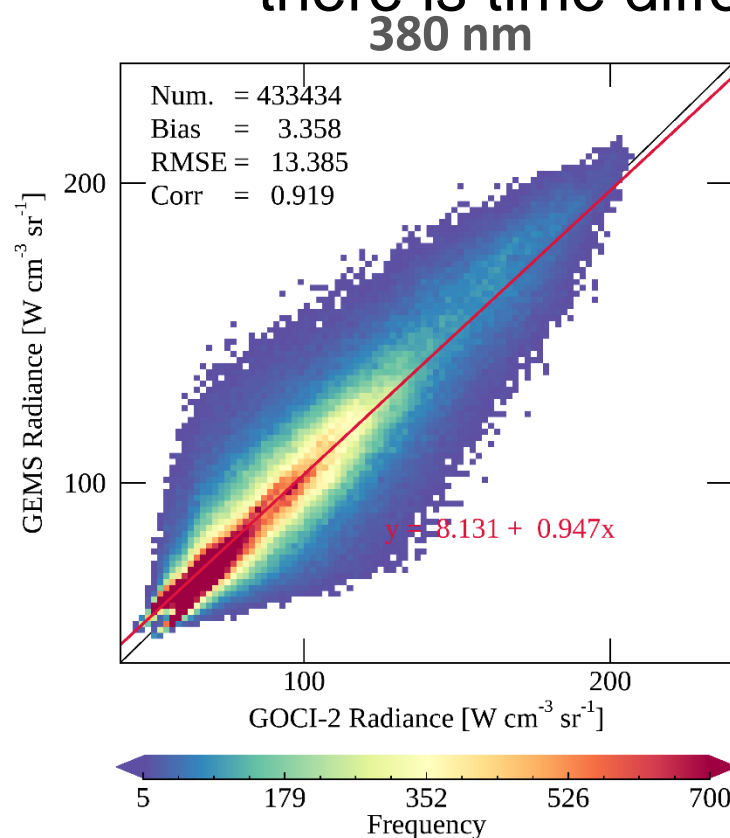


Sensor	AMI	GEMS	GOCI-2
Spectral range [nm]	470	300-500 ($\Delta\lambda=0.2$)	380, 412, 443
Time interval	Every 10 min.	hh:45 (00-08 UTC)	hh:15 (00-08 UTC)
SZA & VZA	$\theta < 40^\circ$		

Inter-comparison with GK-2A/B imagers

❖ Comparison with GOCI-II

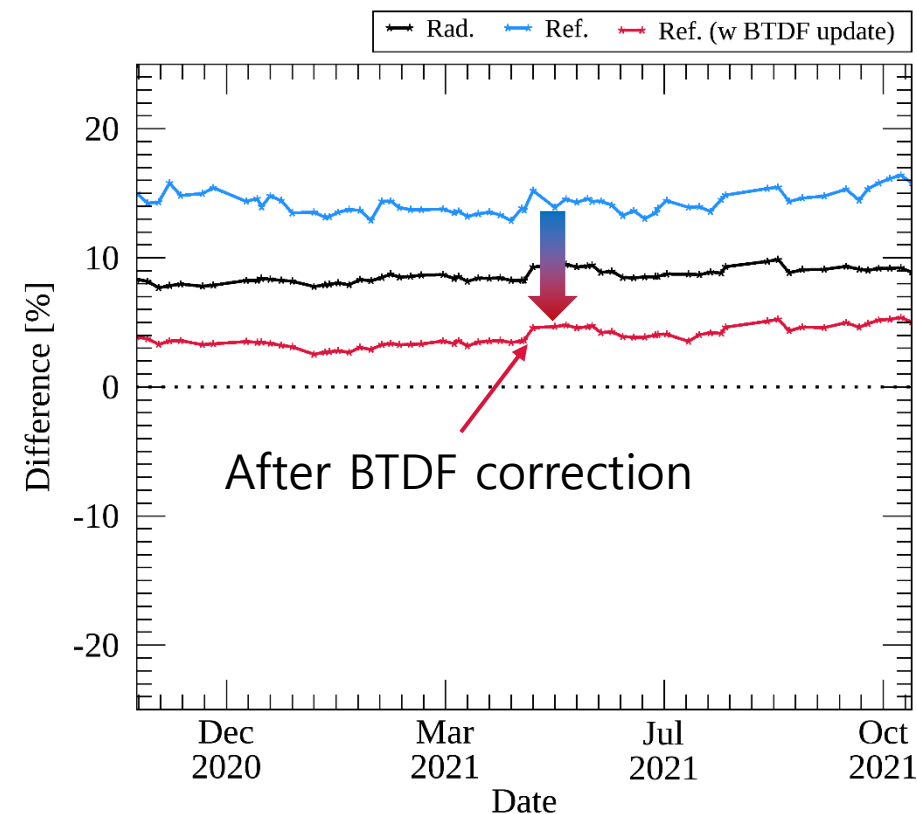
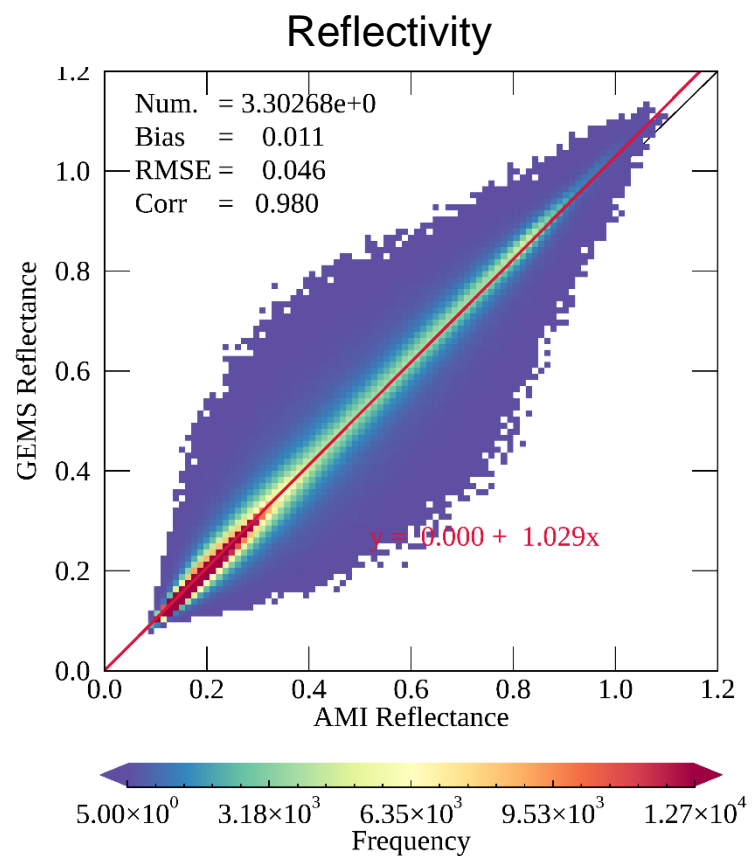
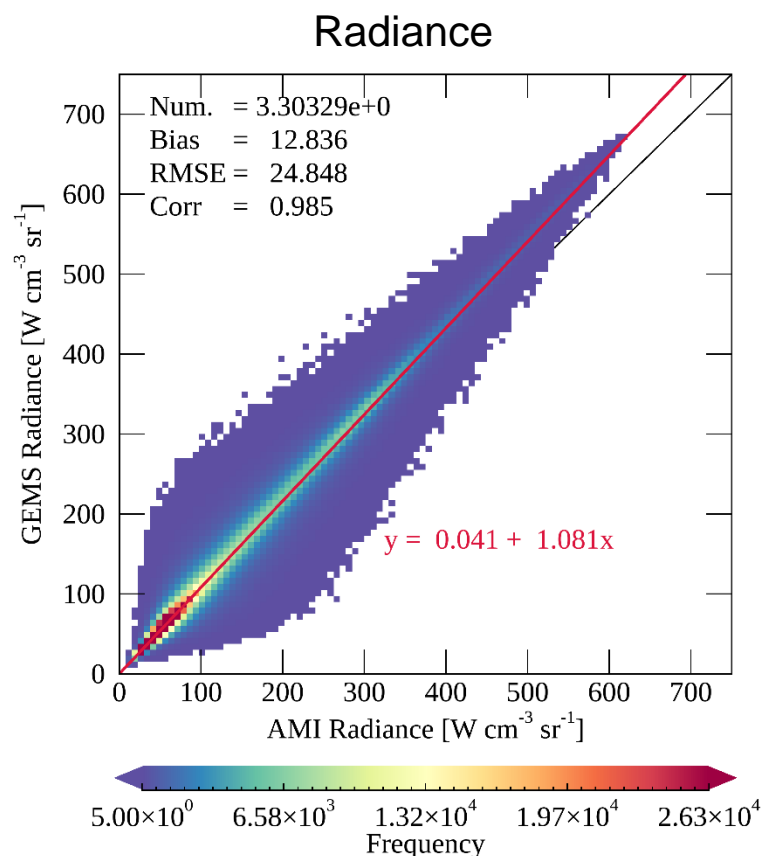
- Without any filtering process, correlation is about 0.91 (although there is time difference between the two measurements)



Inter-comparison with GK-2A/B imagers

❖ Comparison with AMI

- GEMS shows slightly higher radiance/reflectivity compared to AMI



Summary and future works

❖ GEMS is slowly aging with an expected degradation

- BTDF irregularity is mitigated with empirical correction, while the stray light and absolute calibration issues are still there
- Dark current and FPE temperature are slowly increasing, while the other spectral and radiometric characteristics are quite stable
- Spectral characteristics are quite stable (see Mina's talk)
- Comparison with the collocated GK-2A/B imagers shows a good agreement with the systematic differences in both radiance and reflectivity

❖ Near future activities

- Finalizing the empirical BTDF approach with the release of new irradiance dataset
- Improve stray correction, especially at the shorter end of spectrum
- Continuous monitoring of the GEMS health conditions



Thank you