

GEMS Performance and Lessons Learned

Mina Kang, Myoung Hwan Ahn, Yeeun-Lee, Mijin Eo, Jhoon Kim

CEOS AC-VC-19/ACSG Joint Meeting 2023 (Oct. 24 to 27, 2023)

Contents

◆ **In-Flight Characterization & Calibration**

- ❖ Spectral performance
- ❖ Radiometric performance

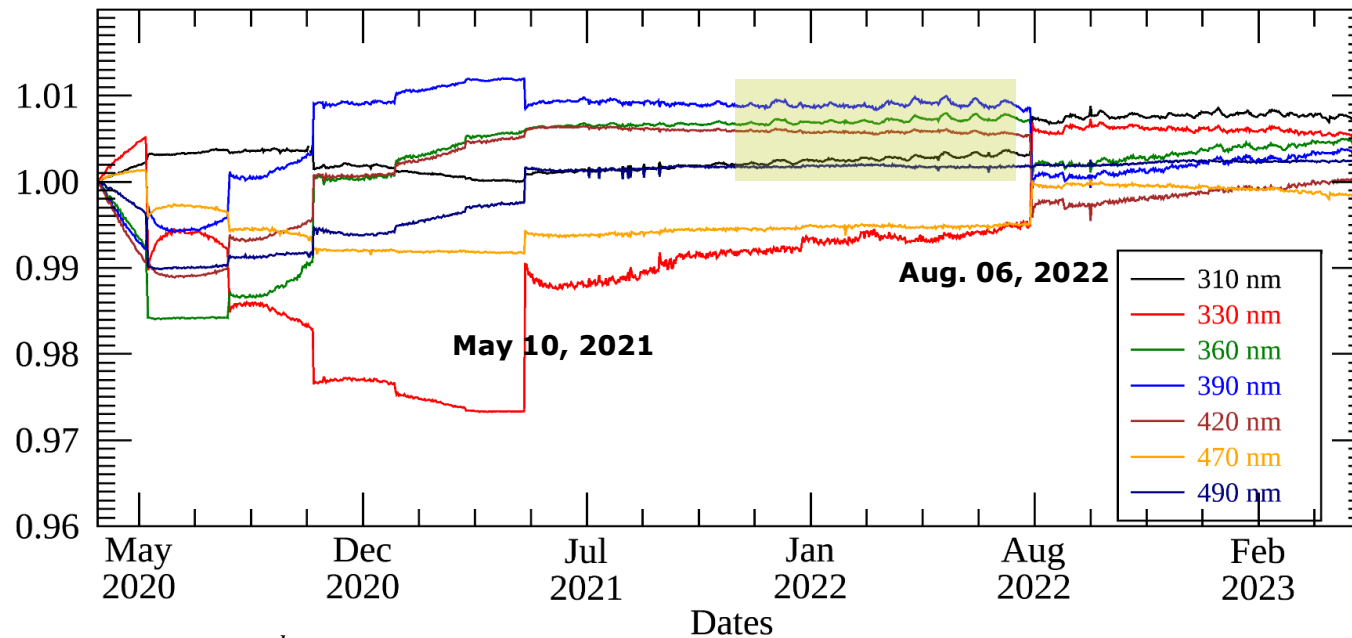
◆ **Trend Monitoring**

- ❖ Diffuser degradation
- ❖ Detector damage

Spectral Performance

◆ Monitoring of spectral parameters

Relative change in FWHM of GEMS SRF compared to April 23, 2020 as determined by a Super Gaussian (SG) fit



$$* SG(x) = \frac{k}{2w\Gamma\left(\frac{1}{k}\right)} e^{-\left|\frac{x}{w}\right|^k}$$

*Full width at Half Maximum (FWHM) = $2\sqrt[k]{\ln 2}w$

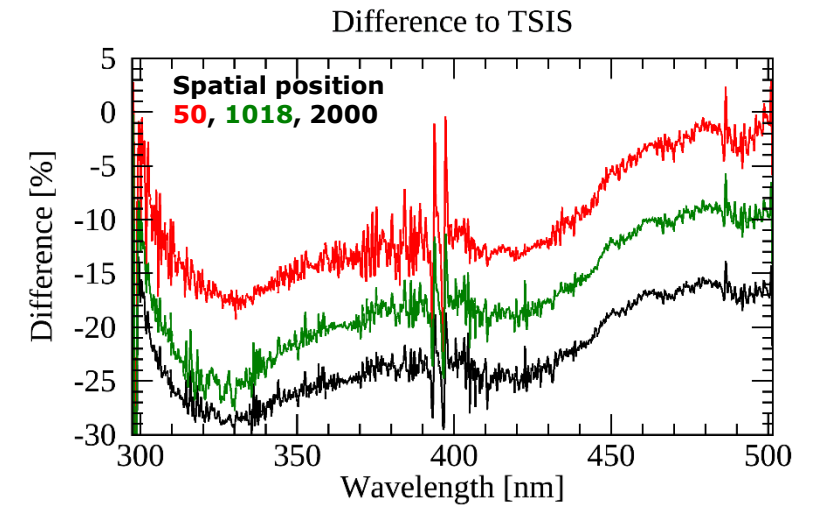
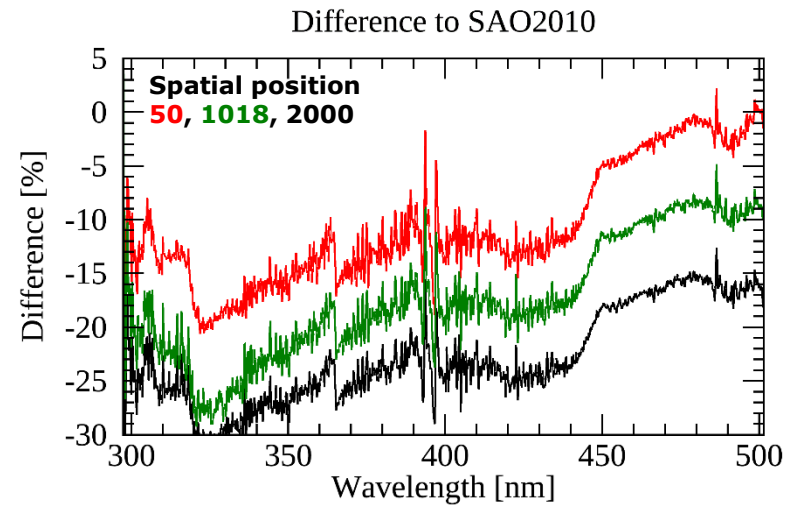
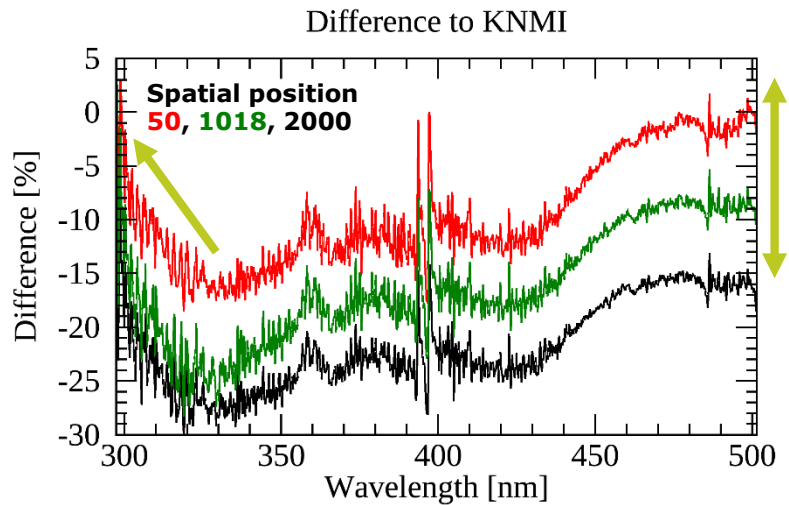
Maintained in accord with the prelaunch characterization

Less variability and a gradually **stabilizing signal**

Correlated with temperature where sunlight strikes the instrument

Radiometric Performance

◆ Characteristics of GEMS irradiance



KNMI: Dobber et al., 2008

SAO2010: Chance and Kurucz 2010

TSIS: Coddington et al., 2021

F_{GEMS} : GEMS irradiance measured on Jun. 30, 2022

F_{ref} : High resolution solar reference spectrum convolved with GEMS SRF

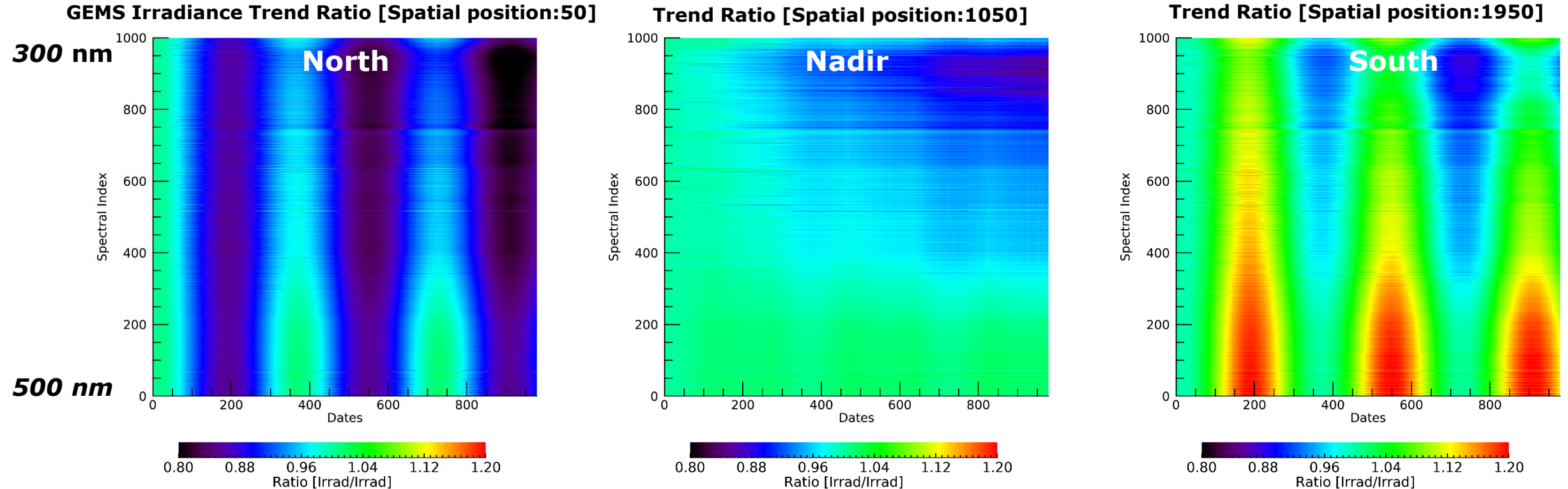
Lower than reference spectra

Higher earth reflectance compared to
OMPS, TROPOMI and AMI

Residual stray light at the 300 to 320 nm

Radiometric Performance

◆ Characteristics of GEMS irradiance



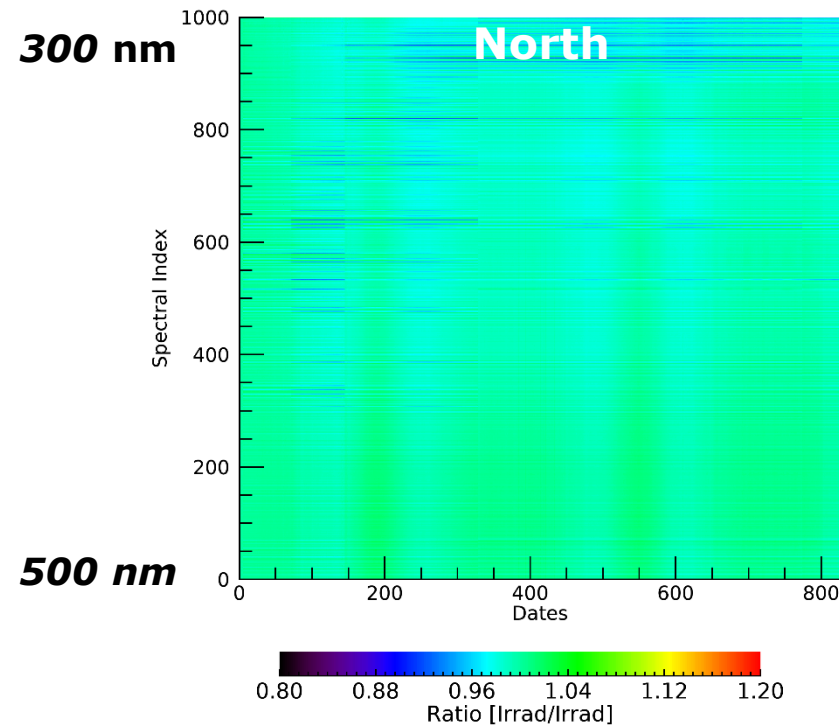
Spatio-spectral variations persist even after radiometric calibration

Least variation occurs at nadir position, with notable degradation in irradiances at shorter wavelengths

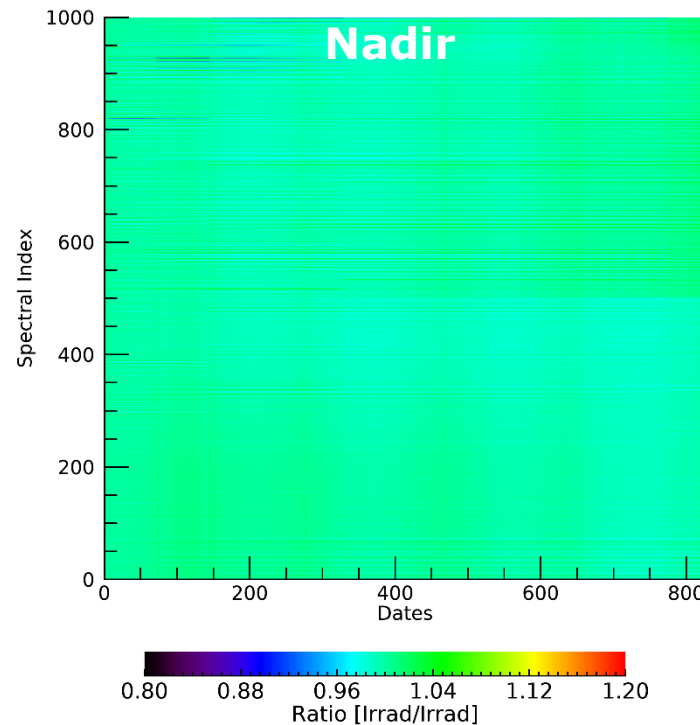
Radiometric Performance

◆ Characteristics of GEMS irradiance

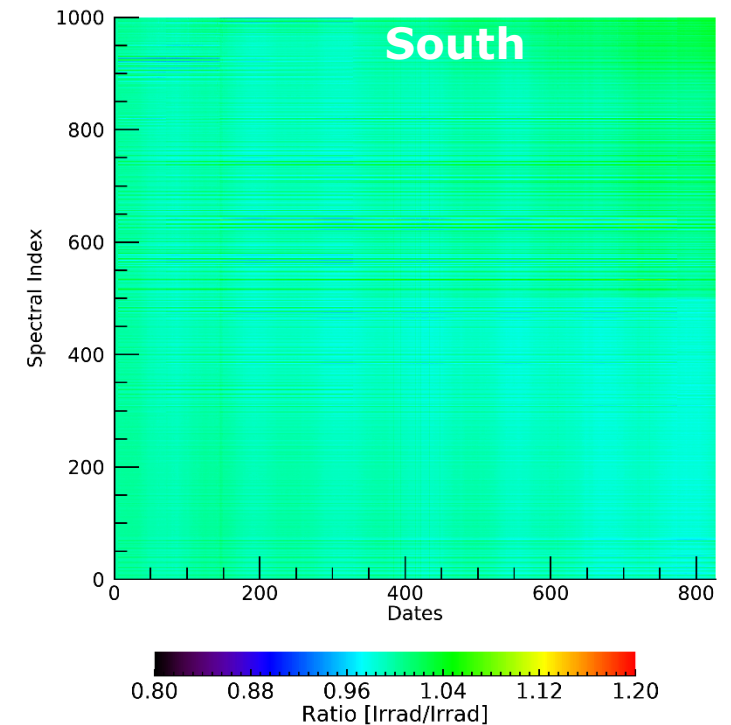
GEMS Irradiance Trend Ratio [Spatial position:50]



Trend Ratio [Spatial position:1050]



Trend Ratio [Spatial position:1950]



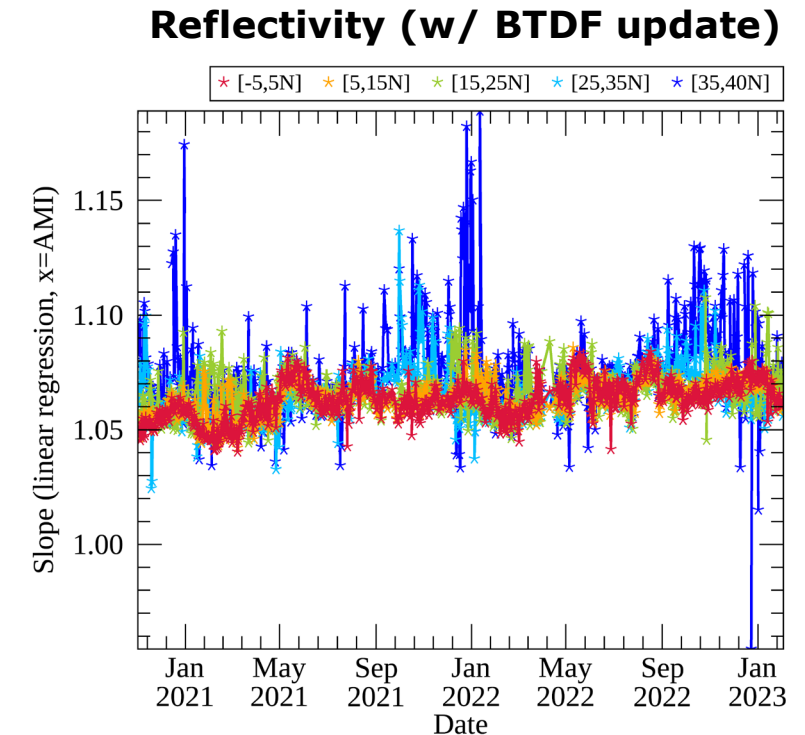
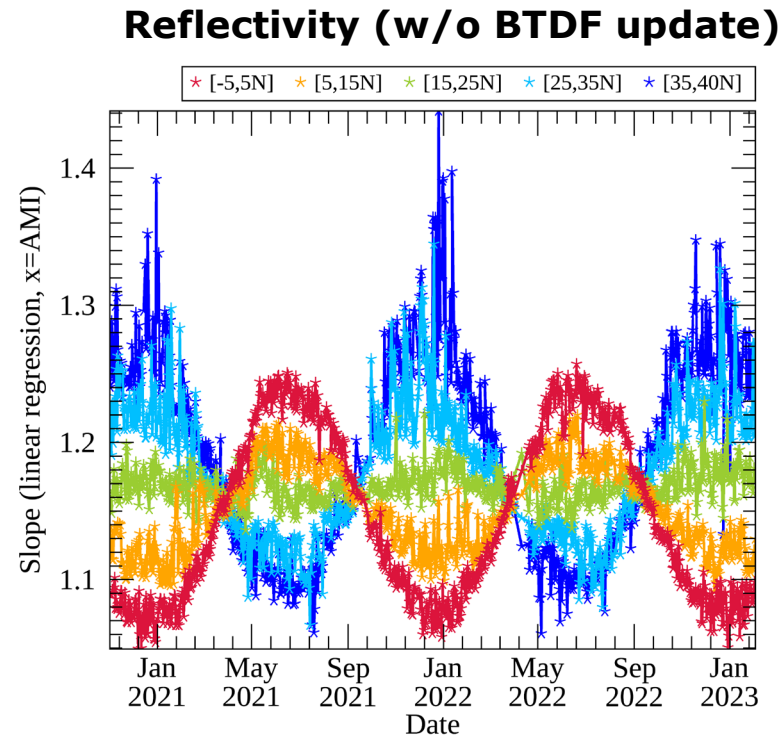
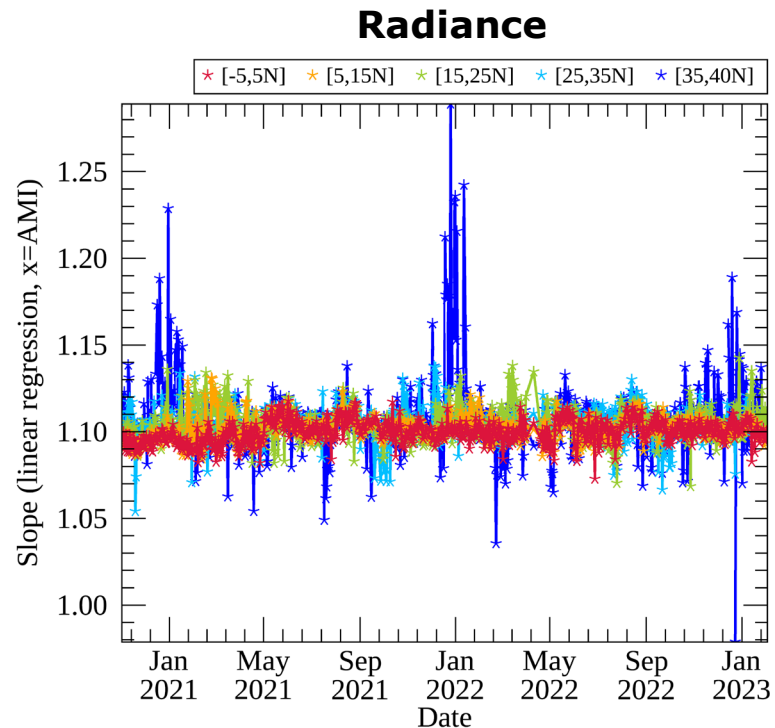
Spatial inhomogeneity significantly reduced from 20% to within 4% after BTDF correction

Impact on Level 2 data is currently under investigation

Radiometric Performance

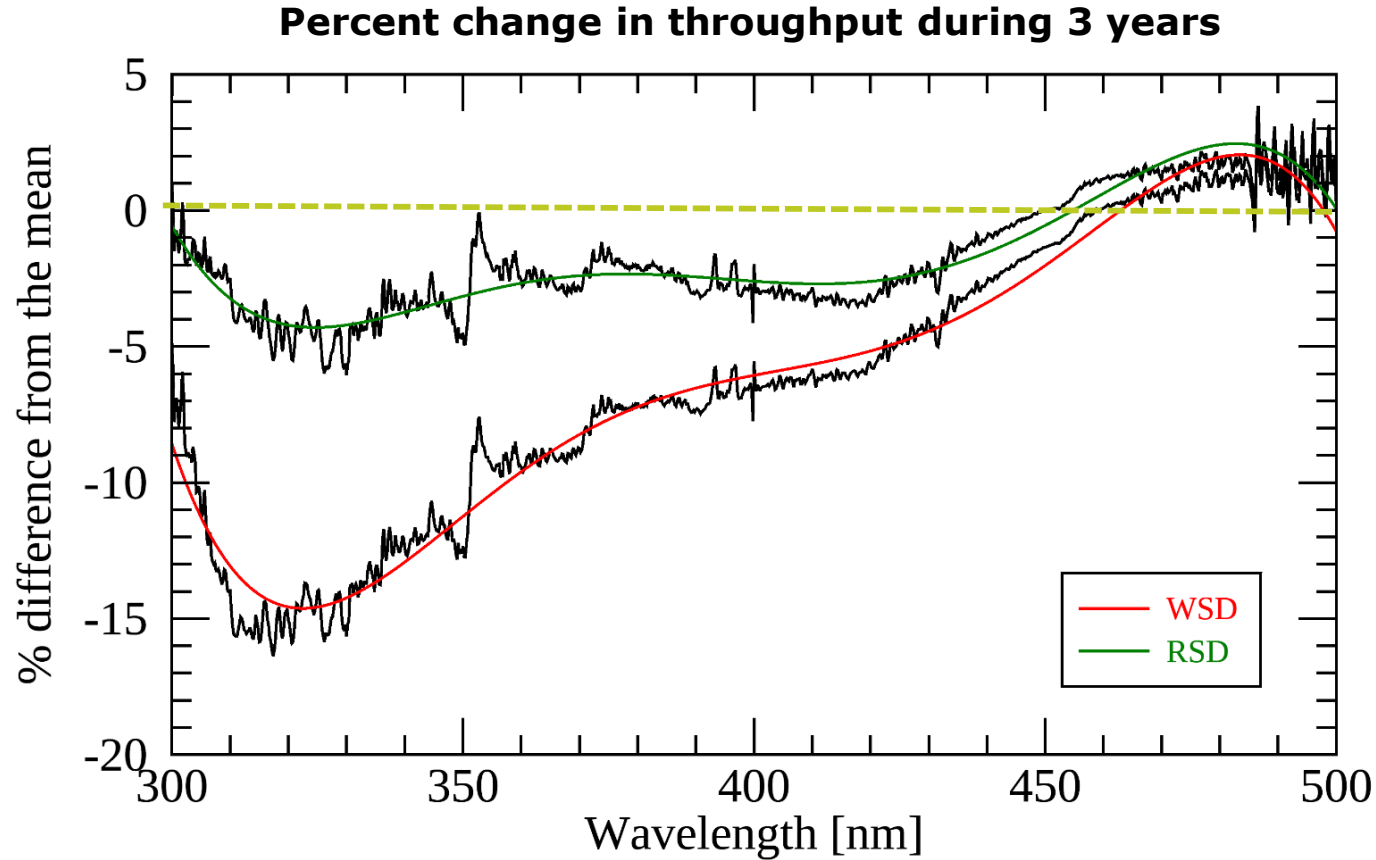
◆ Characteristics of GEMS radiance & reflectance

❖ Inter-calibration approaches using AMI



Trend Monitoring

◆ Degradation



RSD measurements also shows degradation

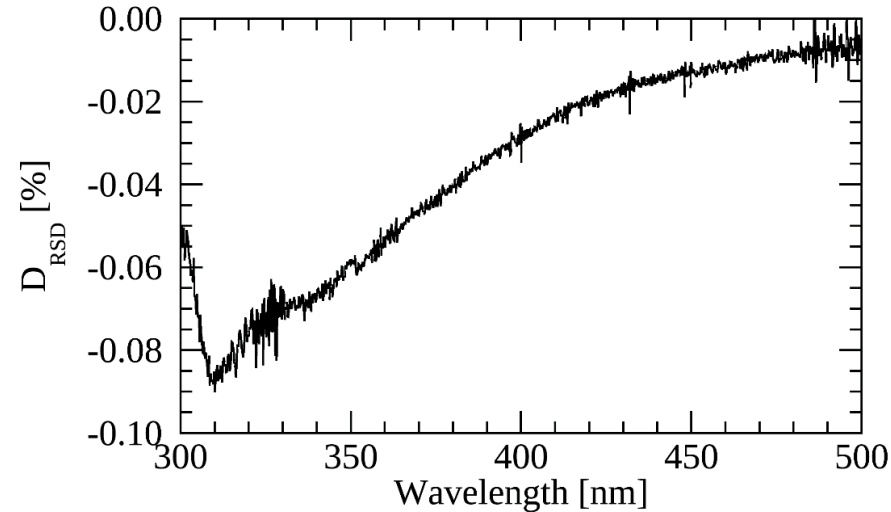
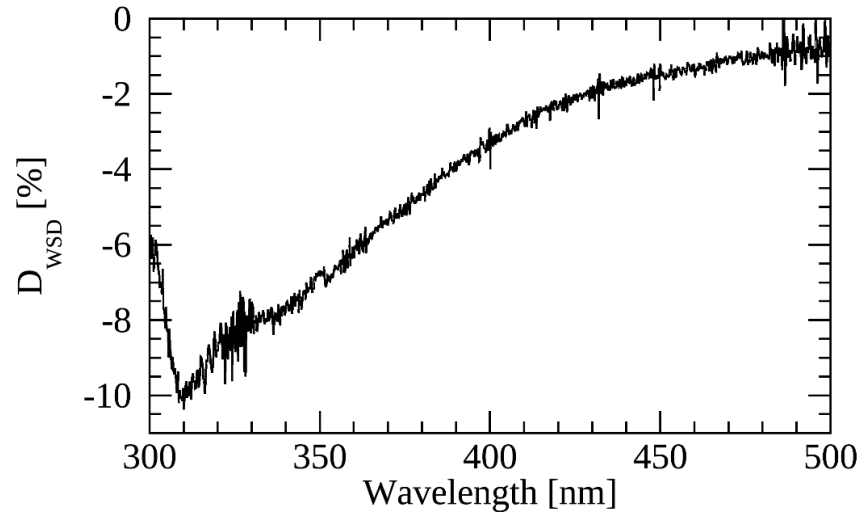
sensor changes occur

Significant degradation at 320 nm

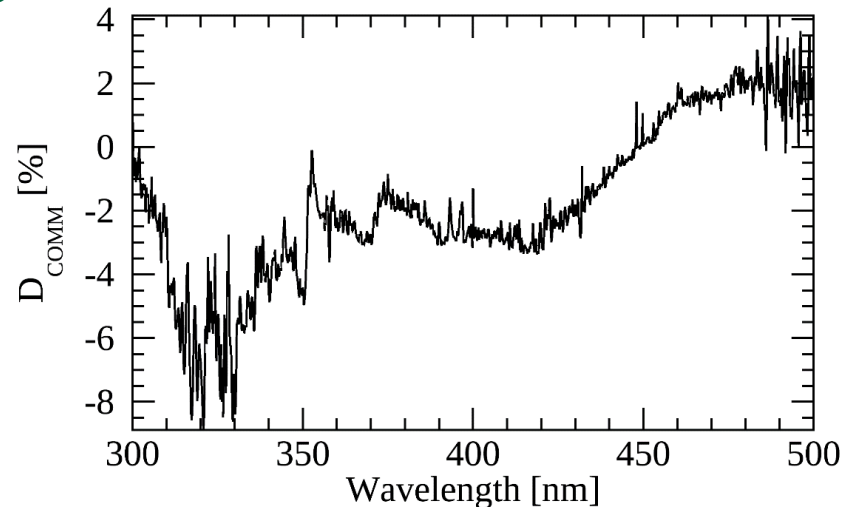
Increasing trend above 450 nm

Trend Monitoring

◆ Estimation of diffuser degradation and instrument changes

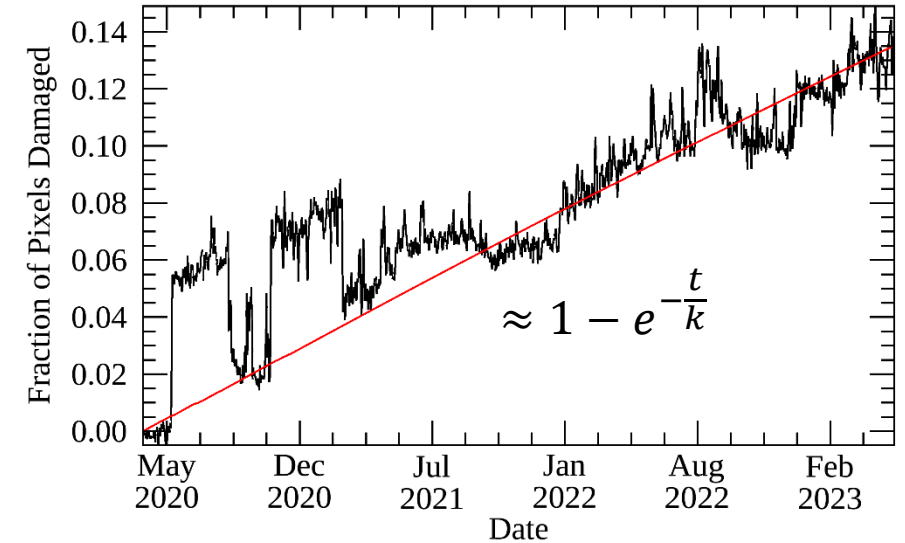
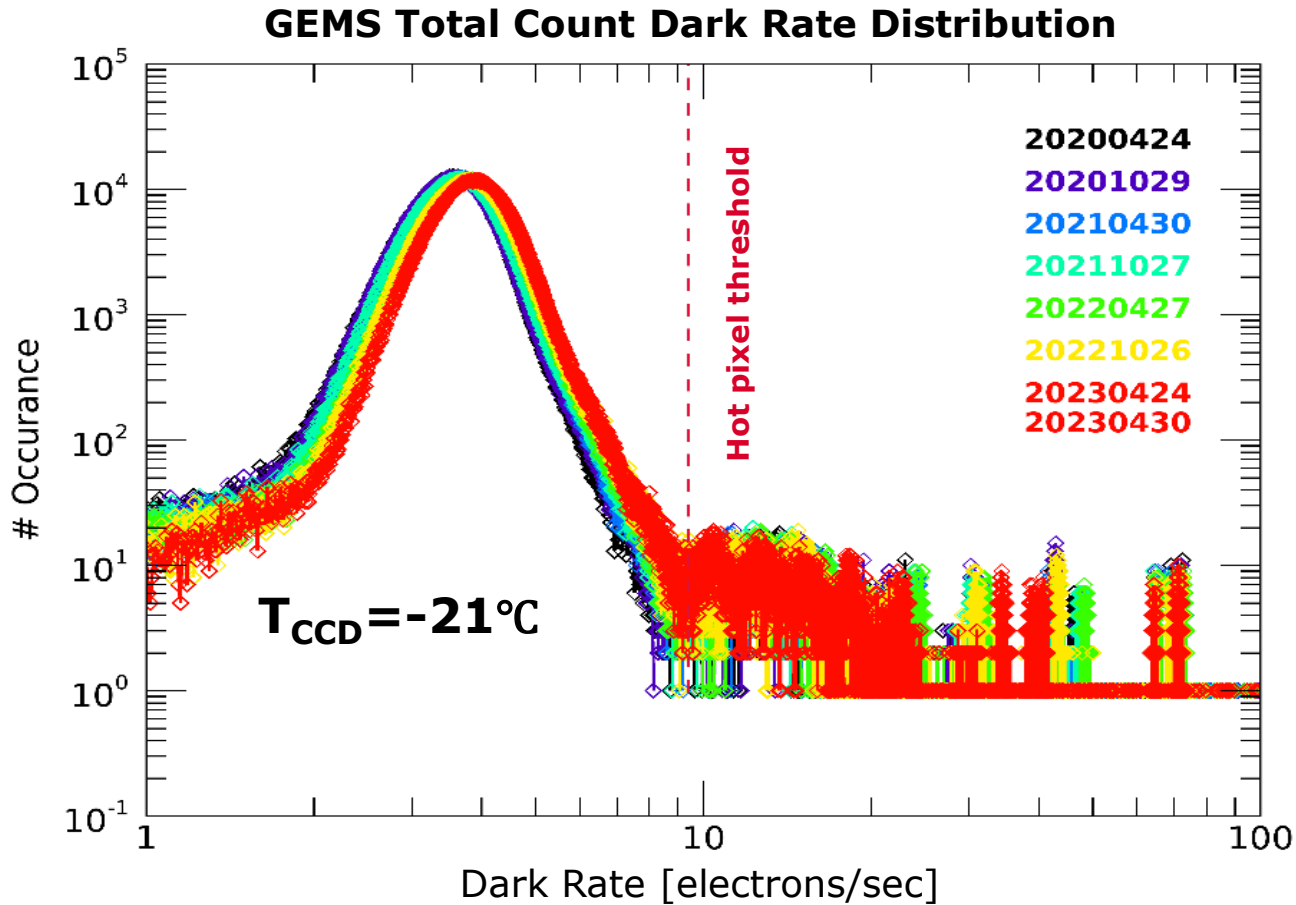


10.2% @ 310 nm for 1036 exposures



Trend Monitoring

◆ Detector damage



Slow increases in hot pixels
e*-folding time ($1/k$) approximated at **21 yrs*

Conclusions

◆ **GEMS Performance**

- ❖ Achieved expected performance with several exceptions
- ❖ Early resolution of spectral characteristics
- ❖ BTDF irregularities reduced through empirical correction

◆ **Future Focus**

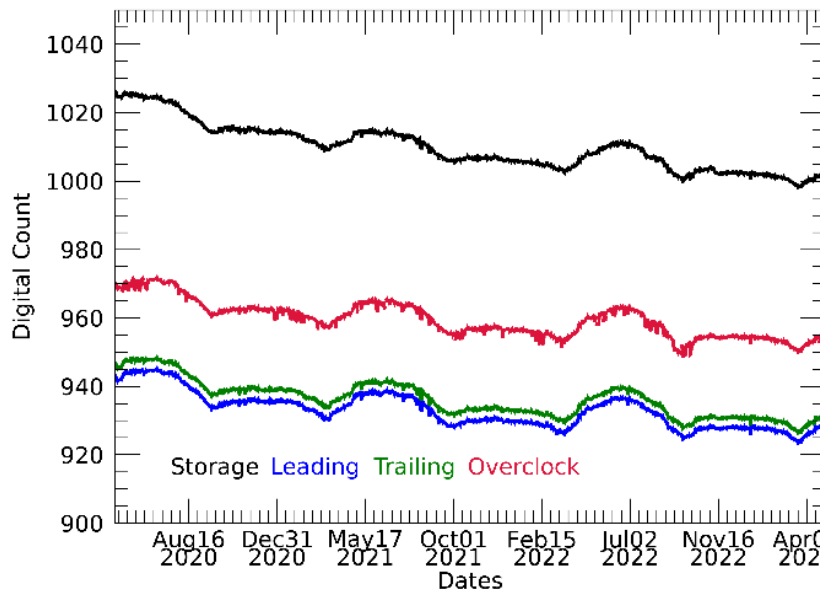
- ❖ Stray light correction
- ❖ Ongoing monitoring of GEMS

Thank you

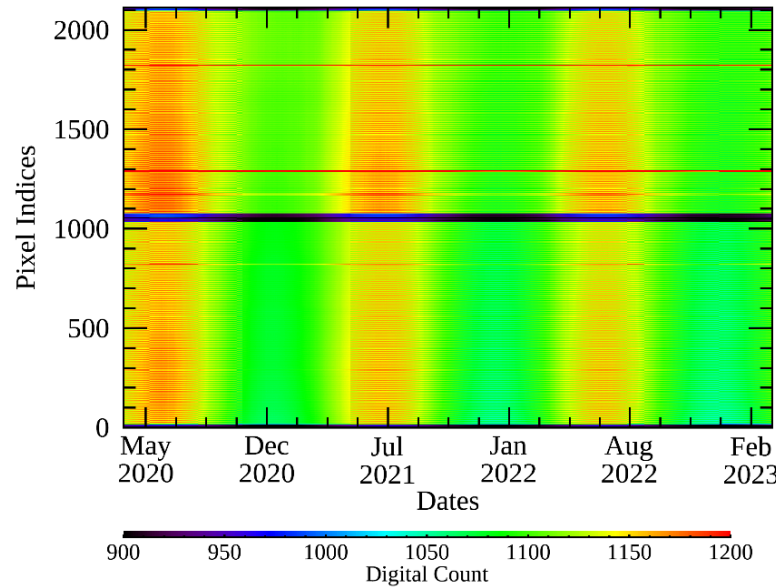
Trend Monitoring

◆ Virtual pixels

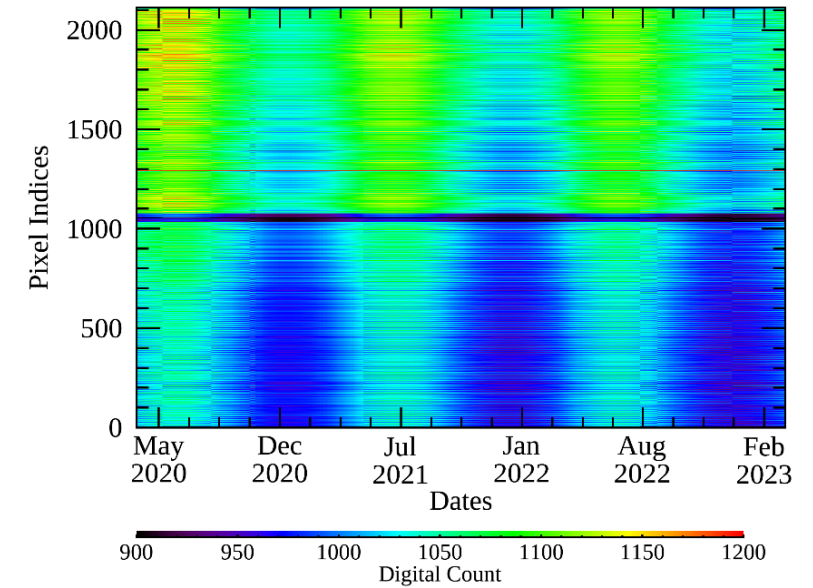
GEMS virtual pixels



Time Series of Smear Pixel



Time Series of Storage Pixel



Offsets show a **decreasing trend over time**