GEMS Performance and Lessons Learned

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CEOS AC-VC-19/ACSG Joint Meeting 2023 (Oct. 24 to 27, 2023)
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◆ **In-Flight Characterization & Calibration**
  - Spectral performance
  - Radiometric performance

◆ **Trend Monitoring**
  - Diffuser degradation
  - Detector damage
Spectral Performance

◆ Monitoring of spectral parameters

Maintained in accord with the prelaunch characterization

Less variability and a gradually stabilizing signal

Correlated with temperature where sunlight strikes the instrument

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) = \(2^k\sqrt{\ln 2} w\)
Radiometric Performance

◆ Characteristics of GEMS irradiance

KnMI: Dobber et al., 2008
SAO2010: Chance and Kurucz 2010
TSIS: Coddington et al., 2021

- Lower than reference spectra
  Higher earth reflectance compared to OMPS, TROPOMI, and AMI

- Residual stray light at the 300 to 320 nm

\[ F_{\text{GEMS}} \text{: GEMS irradiance measured on Jun. 30, 2022} \]
\[ F_{\text{ref}} \text{: High resolution solar reference spectrum convolved with GEMS SRF} \]
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

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

Percent change in throughput during 3 years

RSD measurements also shows degradation
sensor changes occur

Significant degradation at 320 nm
Increasing trend above 450 nm

WSD: working solar diffuser measurement
RSD: reference solar diffuser measurement
Trend Monitoring

- Estimation of diffuser degradation and instrument changes

10.2% @ 310 nm for 1036 exposures
**Trend Monitoring**

◆ **Detector damage**

GEMS Total Count Dark Rate Distribution

![Graph showing dark rate distribution with a hot pixel threshold at T\textsubscript{CCD}=-21°C.]

Slow increases in hot pixels

*e-folding time* \((1/k)\) approximated at 21 yrs

\[\approx 1 - e^{-\frac{t}{k}}\]
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

Offsets show a decreasing trend over time