Comparing SLIMED with GIRO using ABI

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Acknowledgements

- **Hugh H Kieffer** in providing SLIMED model package and extending help and support throughout this comparison work.

- **GSICS community** for the GIRO model.

- Current NOAA GOES-R ABI Calibration Working Group (**CWG**) **team members** for help and support.

Outline

- Introduction
- Objectives
- Method Summary
- Results
- Conclusions

Introduction

- **Lunar irradiance calibration model, GIRO (GSICS implementation of Robotic Lunar Observatory (ROLO) model) is popularly used in the GSICS community.**

- **SLIMED is a new lunar irradiance calibration model developed by Hugh H Kieffer*.**
  - The SLIMED model is based on data from **nine LEO instruments** and **three surface telescopic observatories**.
  - An irradiance libration model derived from lunar orbiter observations was used to reduce the number of coefficients.
  - Compared to GIRO model, SLIMED models are based on 12 times the number of instruments, three times the amount of data, and have 1/10 the number of coefficients and 1/2 the magnitude residuals.

- **SLIMED IDL package was tested by CWG used for this comparison analysis.**

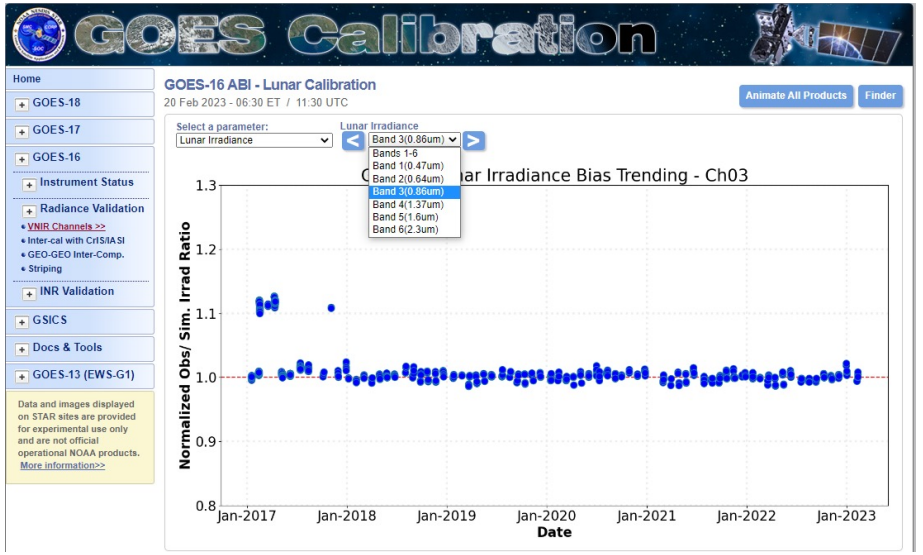
*Reference: H.H. Kieffer, "Multiple-instrument based spectral irradiance of the Moon", J. Appl. Remote Sens. 16(3), 038502 (2022), doi: 10.1117/1.JRS.16.038502.

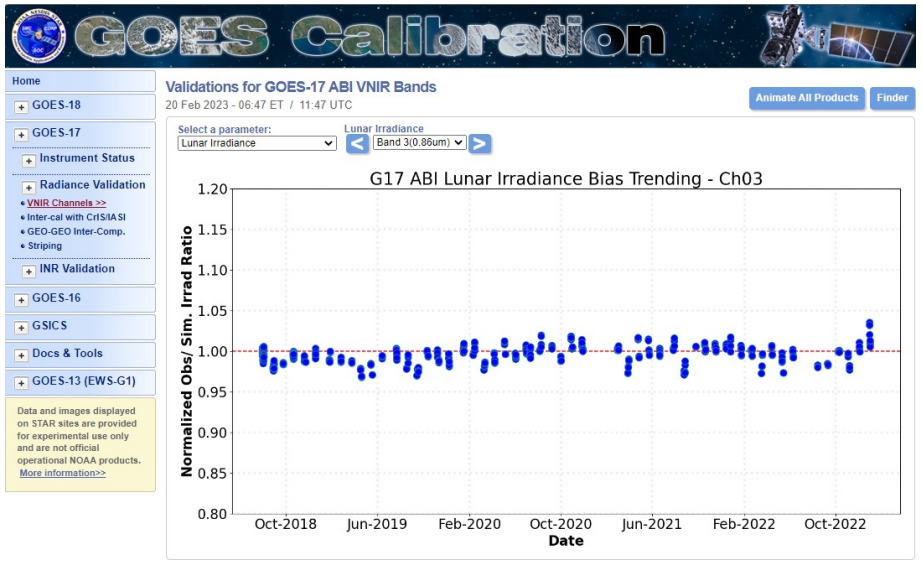
Sample GOES ABI Lunar Imagery

GOES ABI Lunar Monitoring

- **CWG currently uses GIRO Lunar model to process monthly Lunar acquisitions for all ABI VNIR bands.**

- **Results for ABI Lunar monitoring can be found in CWG webpage.**
  - https://www.star.nesdis.noaa.gov/GOESCal/G16_ABI_RadVal_VNIR_static.php
  - Updated monthly.





Objectives

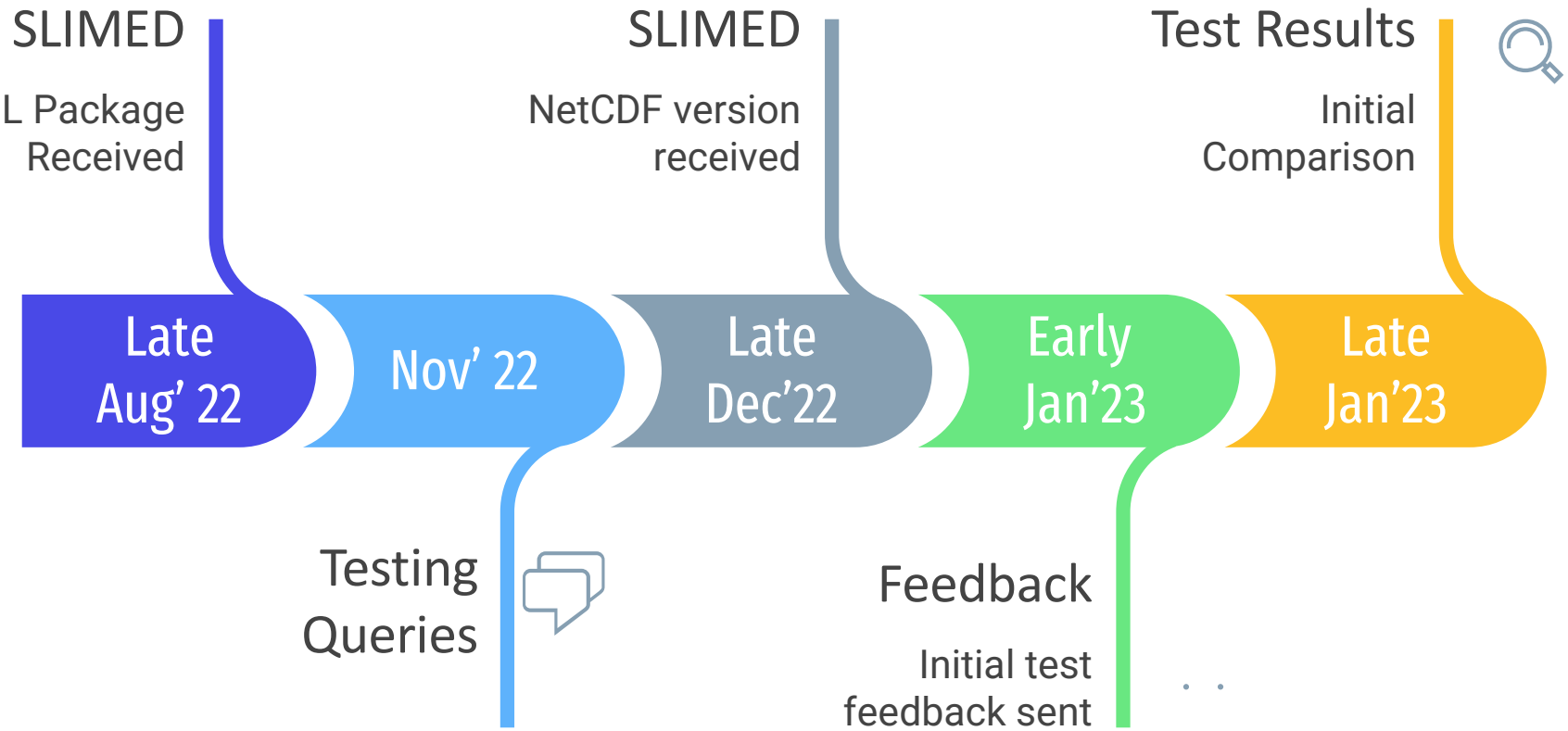
- **Share the experience of SLIMED Lunar model implementation and challenges**

- **Perform an initial comparison of SLIMED lunar model with GIRO Lunar model using GOES ABI dataset.**

ABI Band	Central Wavelength (µm)
1	0.47
2	0.64
3	0.87
4	1.38
5	1.61
6	2.25

SLIMED package implementation timeline

- **SLIMED Lunar model is available in IDL package.**
  - SLIMED Lunar package was successfully run for provided test datasets in the package.
  - Results were validated with available test outputs in the package.



Method summary

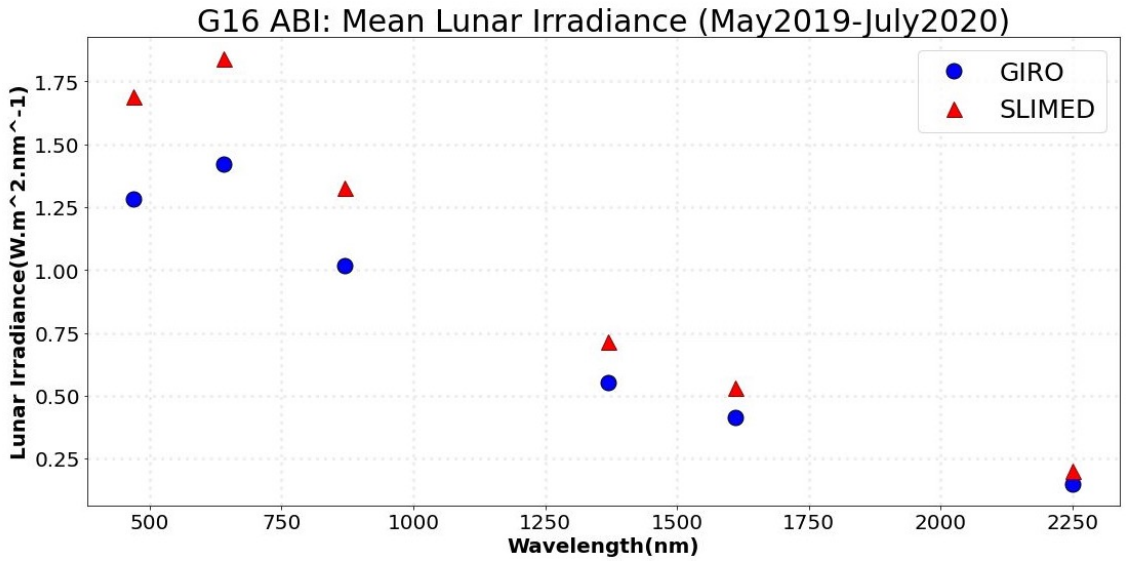
- **Both GIRO and SLIMED model were used to process G16 and G17 ABI Lunar datasets.**
  - May'19 – July'20.

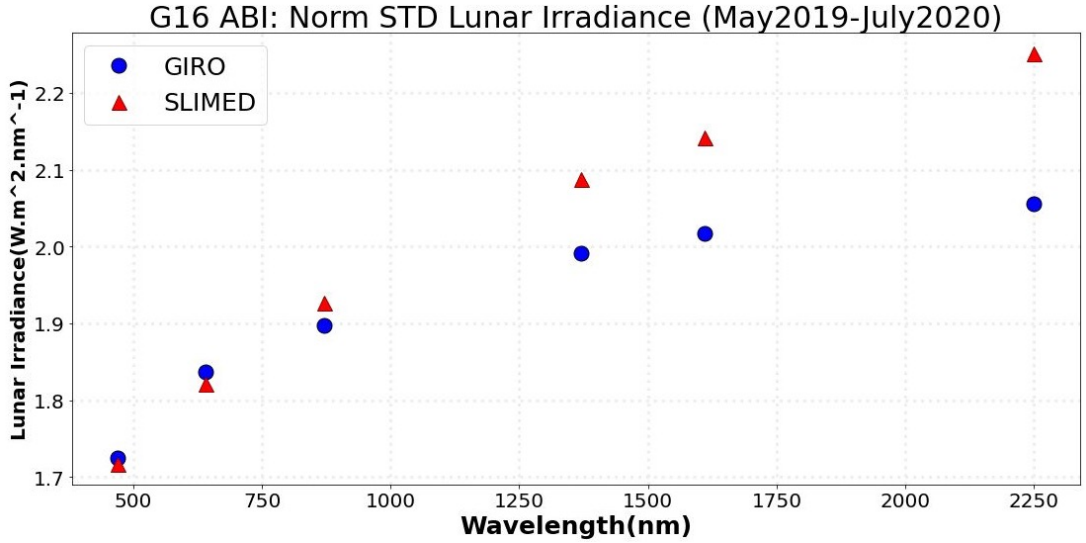
- **Comparison between Lunar models was performed**
  - Absolute irradiance for each wavelength
  - Irradiance ratio(observed/model)
  - Irradiance ratio across Lunar Phase angle

- **Normalized STD error metric for Irradiance ratio were used to quantify the differences.**

Mean Absolute Lunar Irradiance Comparison

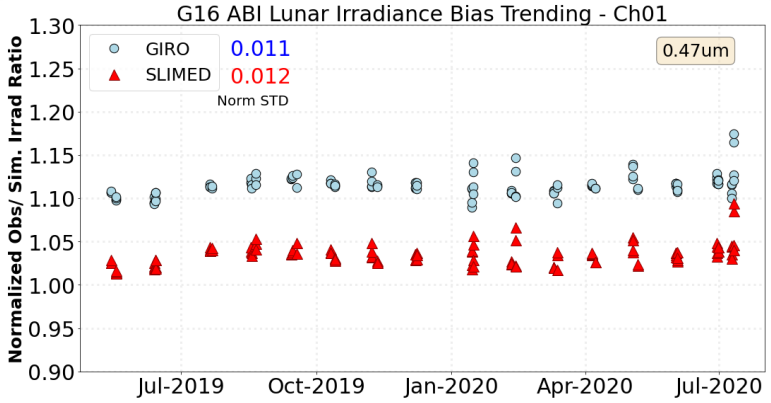
- Mean Lunar Irradiance was computed for ABI dataset (May'19 – July'20).
- Mean Lunar Irradiance is higher for SLIMED model for all ABI bands.
  - Difference in Lunar irradiance between the Lunar models decreased with increase in wavelength.
- Lunar Irradiance STD difference between the models increases with increase in wavelength.
- Extra plots in backup.

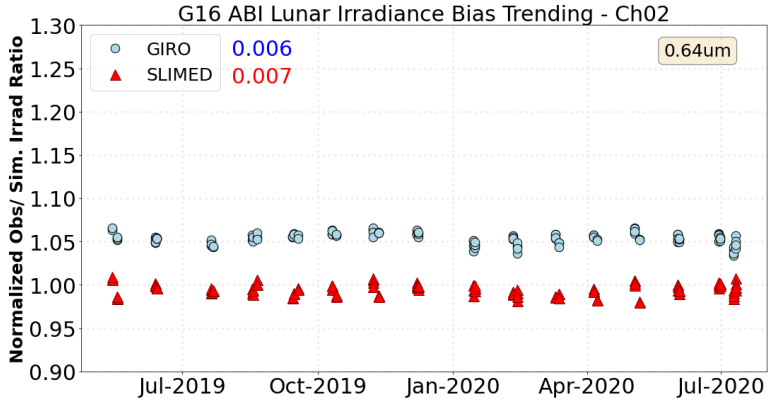


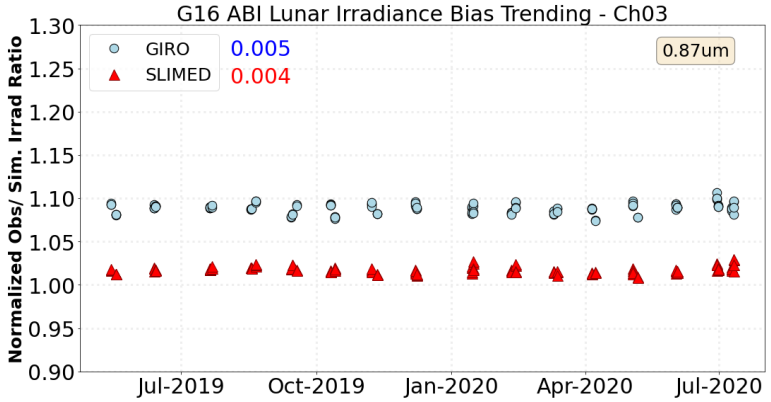


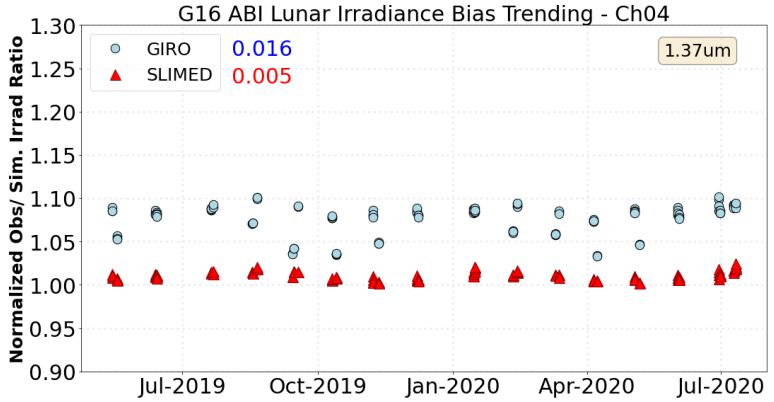
G16 ABI: Lunar Models Performance Comparison

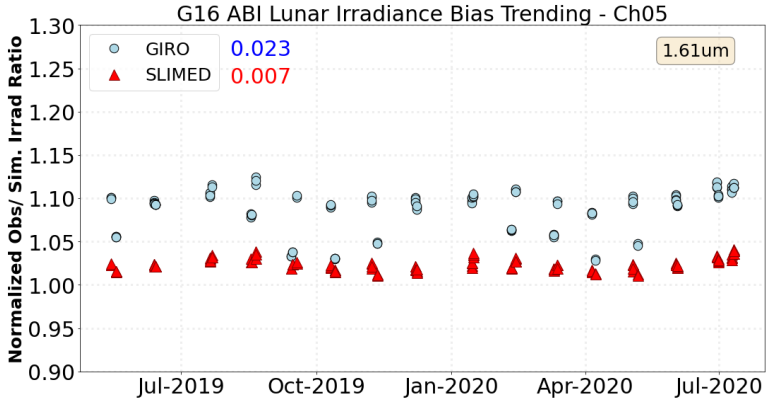
- **B1, B2 & B3:** Similar performance between SLIMED and GIRO model.
  - Norm STD diff within 0.1%.
- **B4, B5 & B6:** SLIMED model show better performance than GIRO model.
  - Norm STD diff greater than 1%
  - Norm STD diff increases with increasing wavelength.
- SLIMED based normalized Irradiance ratio is lower than GIRO for Bands(1-6).

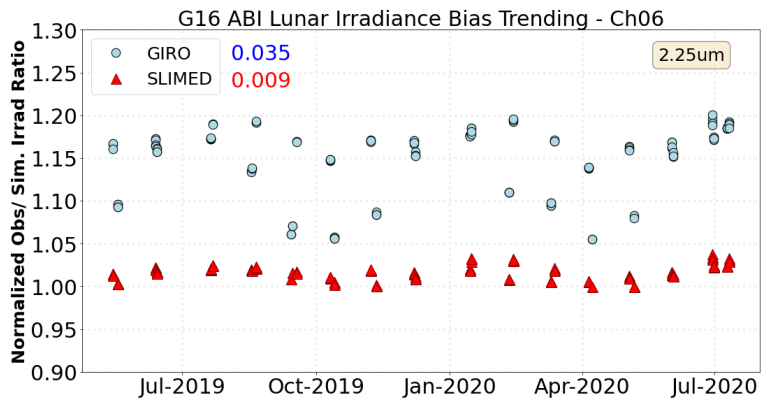








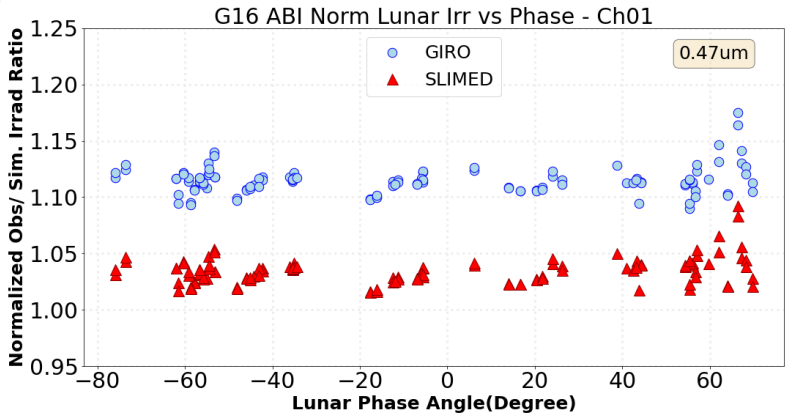


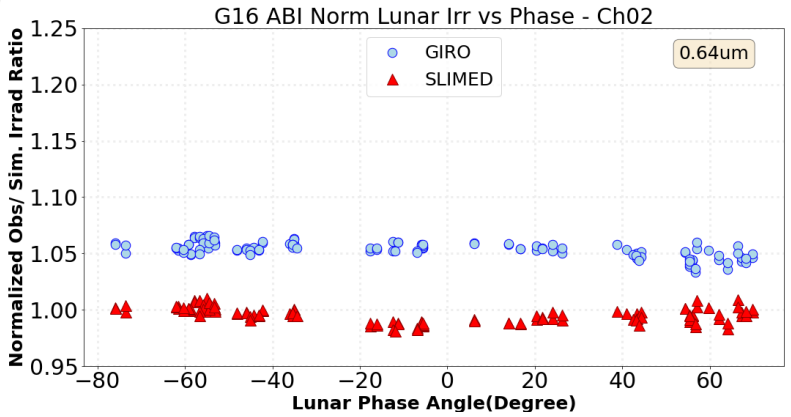


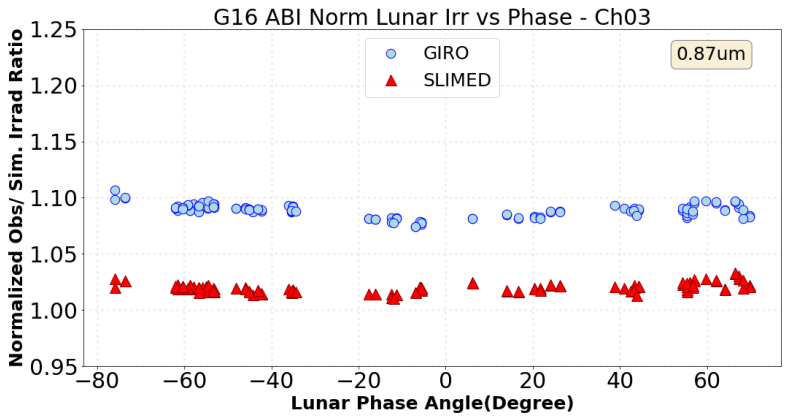
G16 ABI : Lunar Models Phase Angle dependency

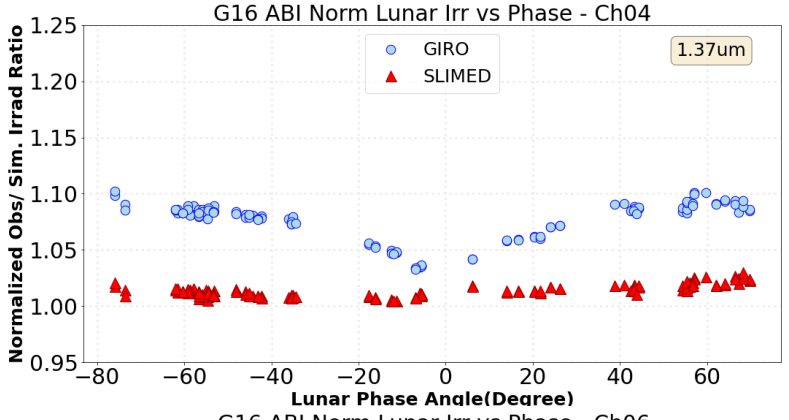
- **B1, B2 & B3:** Slight dependency observed for both SLIMED and GIRO model.

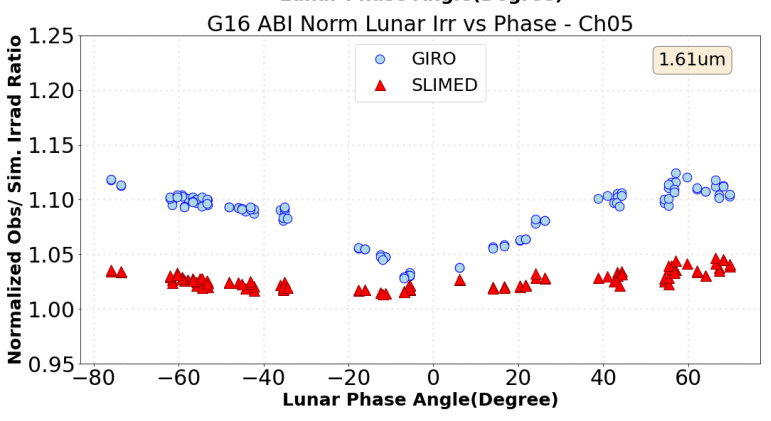
- GIRO model has strong phase angle dependency for **Bands (3-6).**
  - Dependency becomes stronger with increasing wavelength.
  - In comparison, SLIMED model show less phase angle dependency.

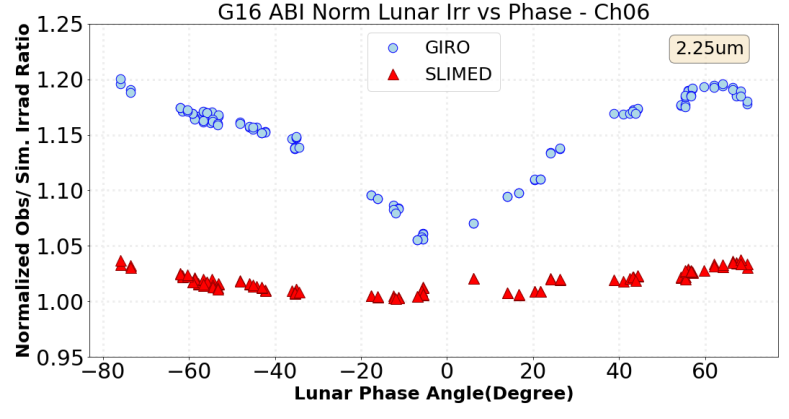












G17 ABI: Lunar Models Performance Comparison

- **B1, B2 & B3:** Similar performance of SLIMED and GIRO model.
  - Norm STD difference within 0.6%.
- **B4, B5 & B6:** SLIMED model show better performance than GIRO model.
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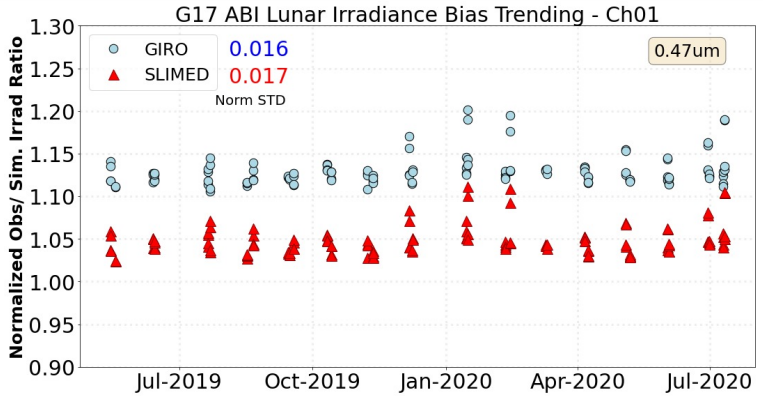
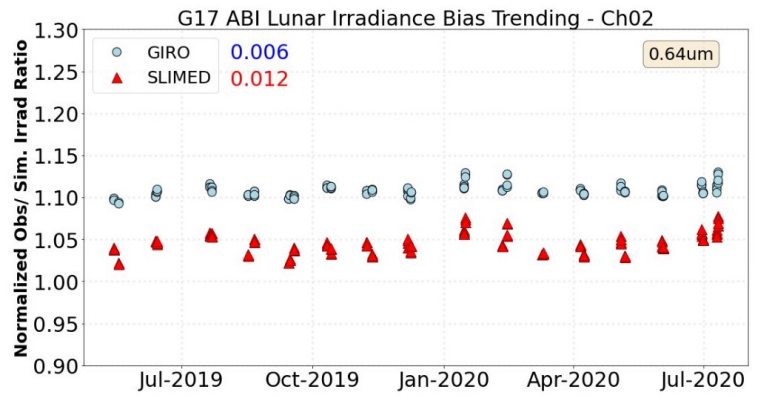
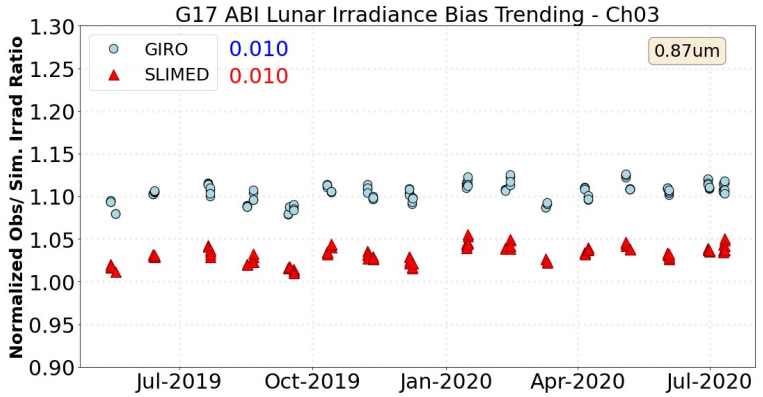
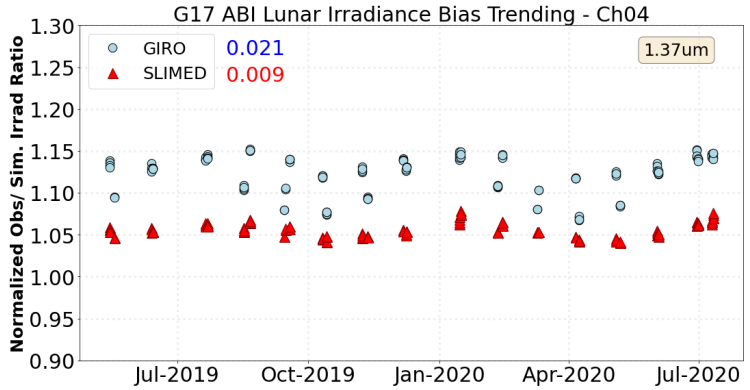
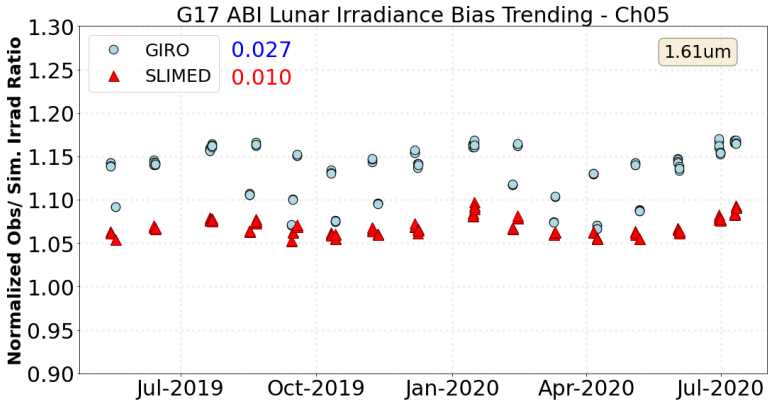
- SLIMED based normalized Irradiance ratio is lower than GIRO for Bands(1-6).

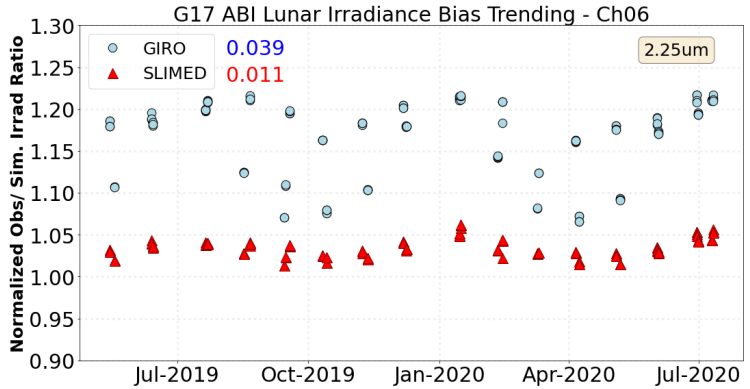






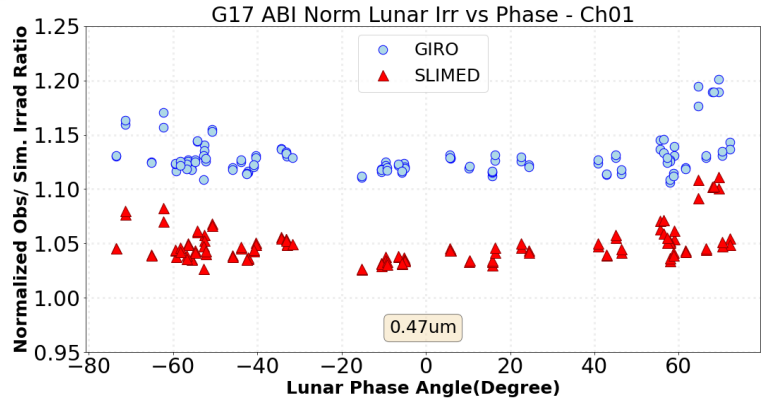


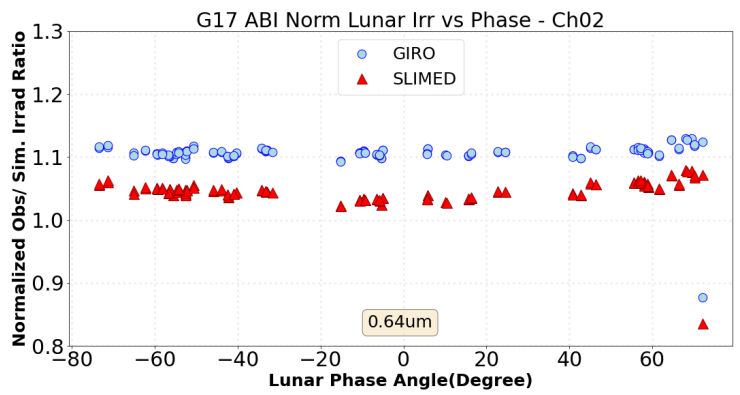


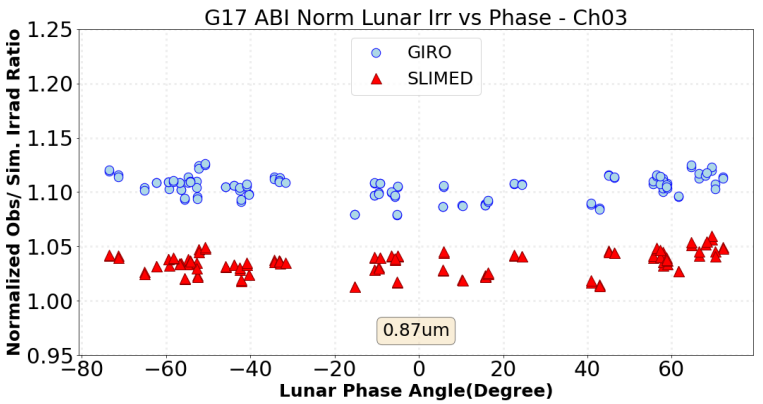


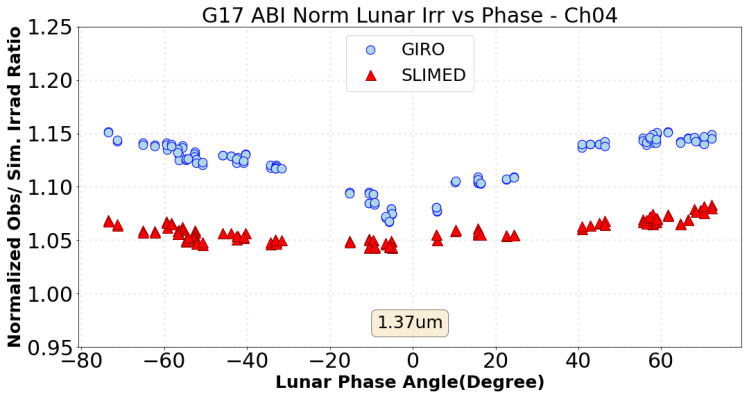
G17 ABI : Lunar Models Phase Angle dependency

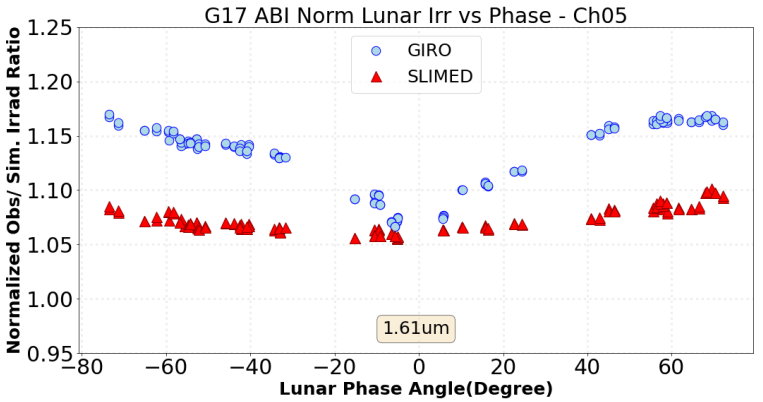
- **B1, B2 & B3:** Minimal dependency observed for both SLIMED and GIRO model.
- GIRO model show strong phase angle dependency for G17 ABI VNIR **bands 4-6**.
- **Similar observations as G16.**

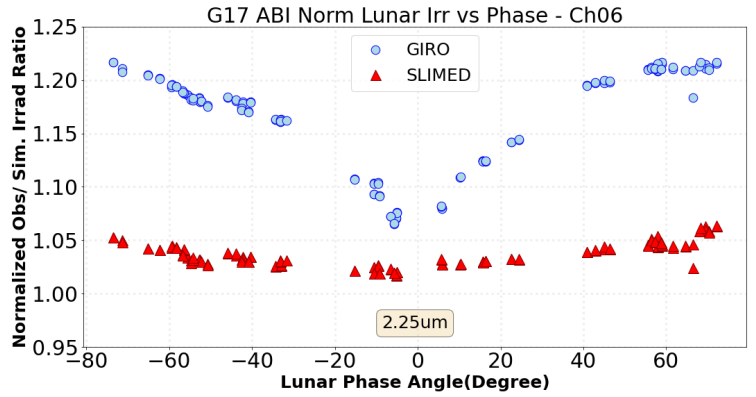












SLIMED package implementation challenges

- **Latest iteration(NetCDF version) of SLIMED IDL package need some updates.**
  - Not implemented by CWG yet
- **SLIMED package update needs**
  - Similar input interface as GIRO model
    - Ability to ingest of same input lunar datasets used by GIRO model
- **Public version (Python) of package will be useful.**
- **Updates on continuous improvement to the SLIMED package is encouraging.**

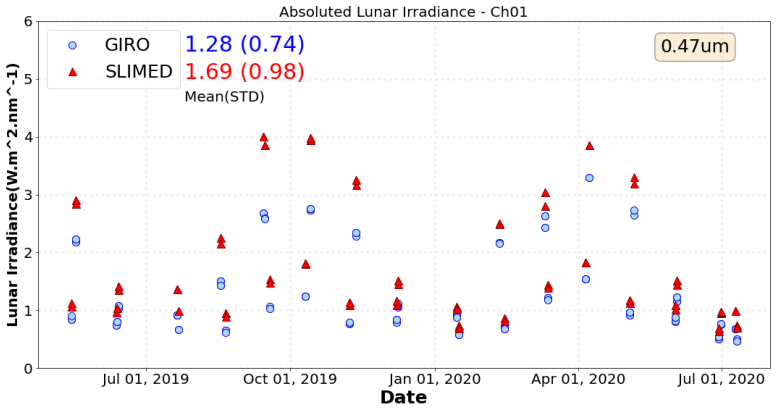
Conclusions

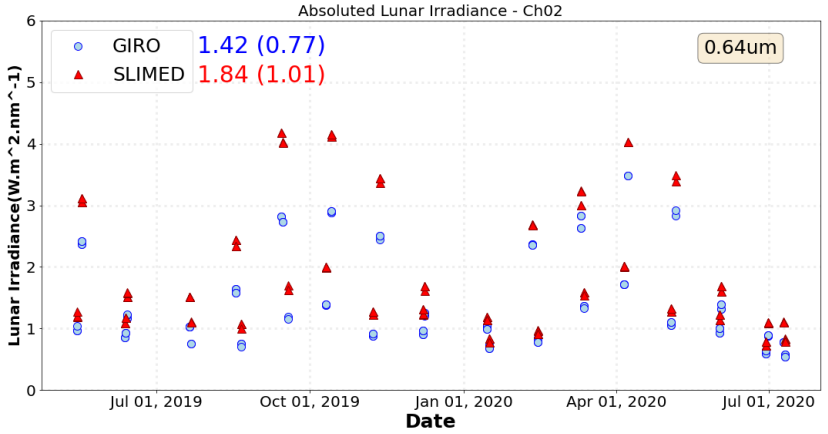
- **SLIMED Lunar package was received and successfully tested by CWG.**
  - Some updates need on its interface side.

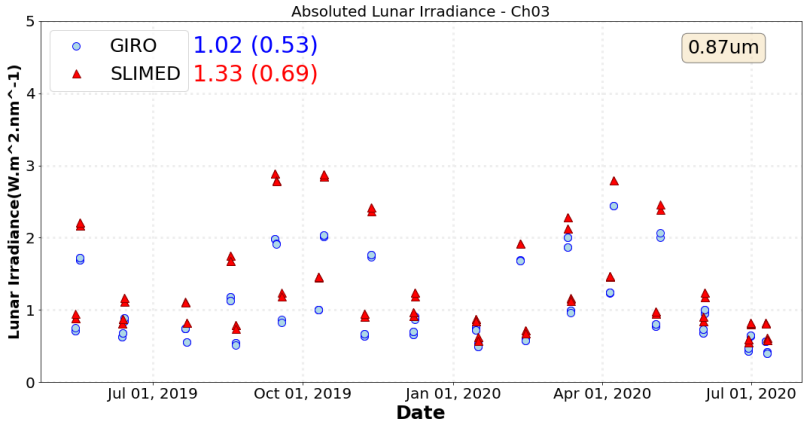
- **Initial comparison between SLIMED and GIRO lunar models were performed for GOES ABI VNIR bands.**
  - **GIRO model has strong phase angle dependency for higher ABI VNIR bands and dependency becomes stronger with increasing wavelength.**
  - For ABI bands 1, 2 and 3, SLIMED model performance was close to GIRO model.
  - For ABI bands 4, 5 and 6, norm STD difference between the models are greater than 1%.
  - SLIMED based Irradiance ratio is lower than GIRO for all ABI VNIR Bands(1-6).

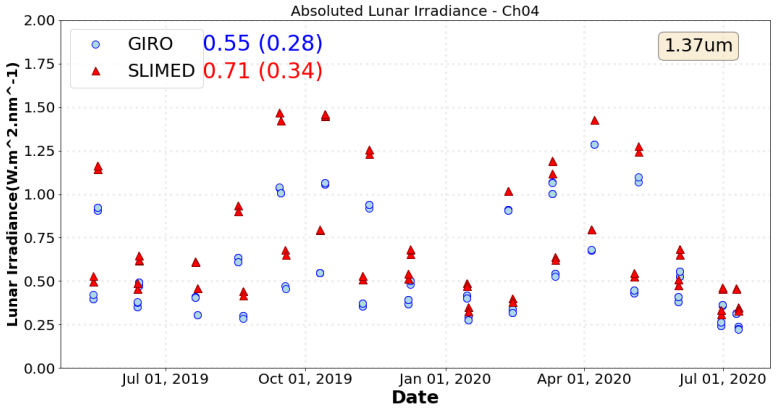
- **Backup Slides**

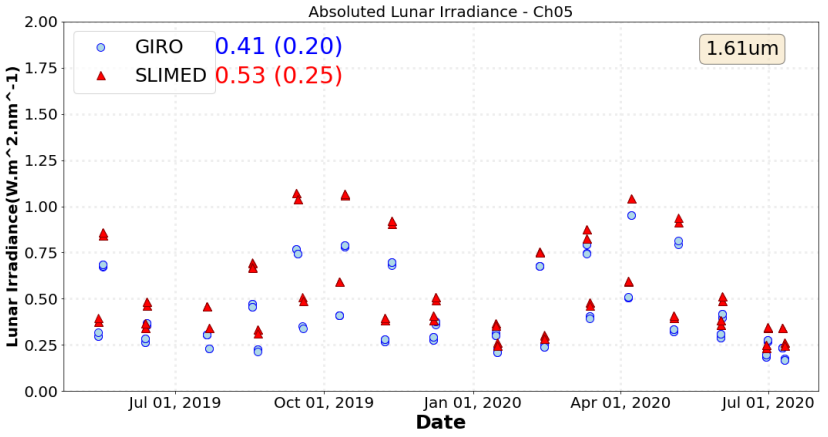
G16 ABI: Lunar models Absolute Irradiance

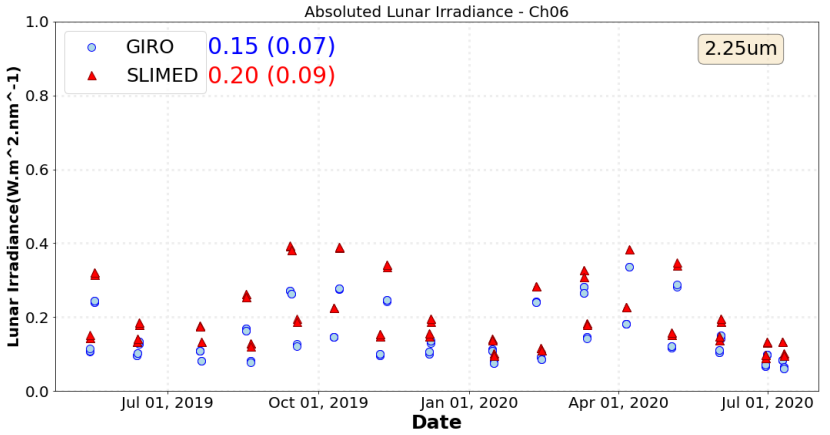












G17 ABI: Lunar models Absolute Irradiance