GSICS Vis/NIR Calibration Activities

David Doelling (NASA)

(GRWG Vis/NIR Sub-Group Chair)

And the GSICS VIS/NIR sub-group members

Overview

- GSICS VIS/NIR calibration strategy
- Lunar Calibration status
- DCC Calibration status
- Solar spectra
- Spectral band adjustment factors
- Discussion

GSICS GEO VIS/NIR calibration strategy

- Use lunar (ROLO model) and Deep Convective Clouds (DCC) calibration to determine the stability of the sensor and to tie the calibration to an absolute reference
  - All GEOs observe the moon and DCC
- Combine lunar and DCC visible calibration gains as the final GSICS calibration
  - Consistent multiple calibration results validates all techniques
  - The combined gain will have a smaller uncertainty than any individual method gain
  - Individual method gains will be made available so that the user may determine calibration method best suited for the application

GSICS VIS/NIR reference calibration strategy

- Use Aqua-MODIS Band 1 Collection 6 radiances as the absolute reference
  - Migrate to NPP-VIIRS
  - Have an unbroken chain of traceable calibration reference records
  - The reference record chain is then tied to an SI-**traceable** on-orbit calibration system sensor, such as CLARREO or TRUTHS

GSICS VIS/NIR SBAF strategy

- Use SCIAMACHY based spectral band adjustment factors (SBAF) to take into account spectral differences between the reference and target instrument
  - If there were a well-calibrated hyper-spectral sensor there would be no need for SBAF
  - The SBAF need to be unique to the spectra used over the GEO and reference sensor intercalibration site
  - Lunar spectra available from ROLO model and SCIAMACHY

Lunar Calibration

- GSICS Implementation of the ROLO model (GIRO) / GSICS Lunar Observation Dataset (GLOD)
  - Intellectual Property Right being cleared in order to distributed to the Lunar Calibration Community members upon agreement with the usage police and the license.
  - Infra-structure for GIRO/GLOD expected in 2016 Q4.
  - Activities planned with USGS to formalise the traceability to the ROLO
- Inter-calibration using the Moon
  - Scheme proposed by EUMETSAT at the last GSICS Annual Meeting in Tsukuba – Japan.
  - On-going study on the validation of SBAF using hyperspectral measurements from SCIAMACHY ➔ Final Presentation in November 2016
  - Interactions between JMA and EUMETSAT on AHI lunar data
- Organisation of a second Lunar Calibration Workshop (still to be confirmed)
  - Co-organised and hosted by the Chinese Meteorological Administration
  - Probably second half 2017
  - Main topics still to be defined
  - GSICS web meeting on 30 August 2016 to initiate the preparation

Courtesy of EUMETSAT

GSICS VNIR product for Meteosat SEVIRI VIS0.6 channel

- GSICS VNIR product in demonstration phase (reference = Aqua MODIS)
- Currently based on Deep Convective Clouds only.
- Applies to VIS0.6 channel on Meteosat-10.
- Near-Real Time and Re-Analysis products generated on a daily basis ➔ stored on EUMETSAT GSICS data server.
- Dataset available on request for Meteosat-9 VIS0.6 (till December 2012).

Future work:

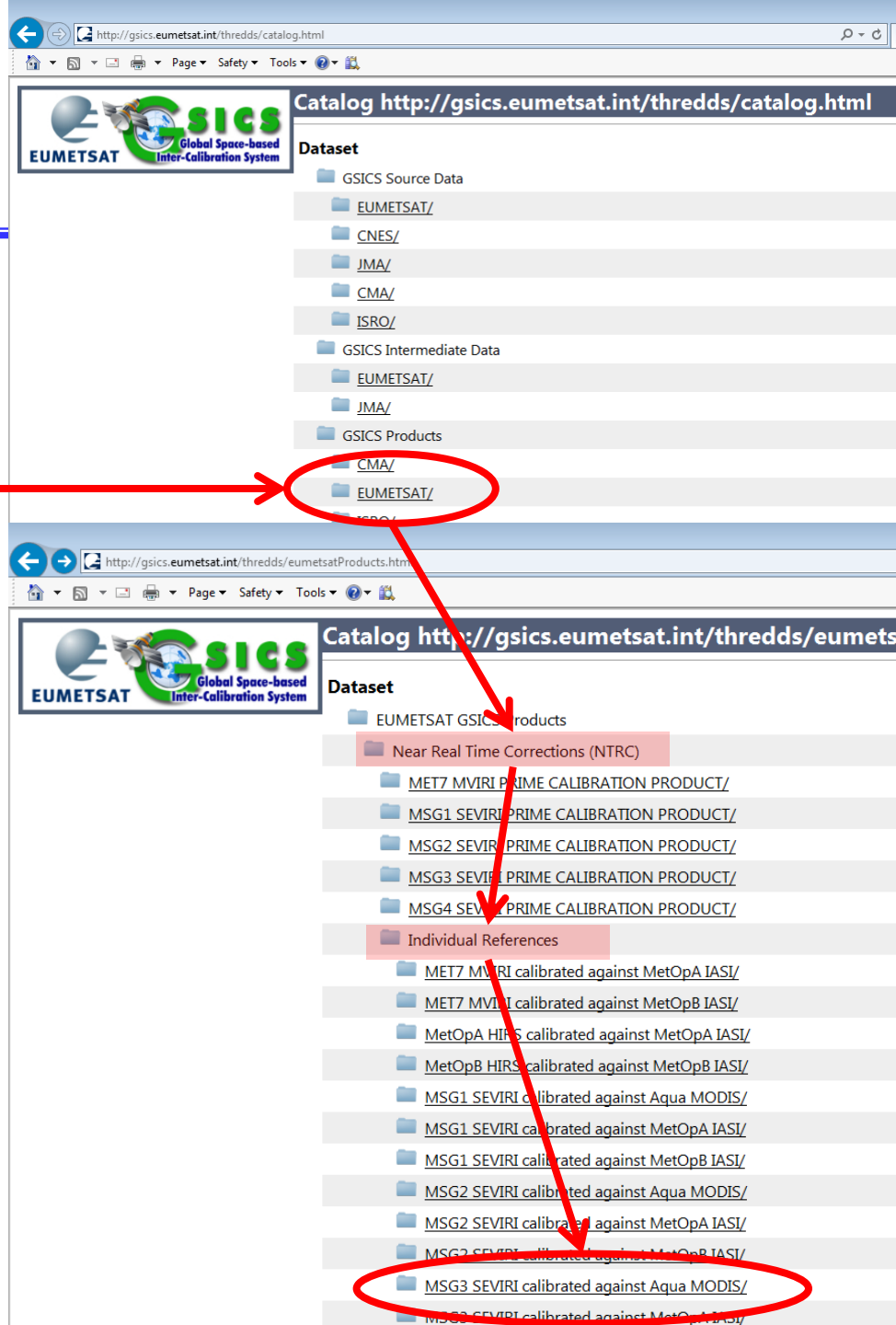
- Change the reference from Aqua MODIS to Suomi NPP VIIRS in order to process more bands (VIS0.8 for instance).
- Complement the DCC method with other methods such as lunar inter-calibration (some questions still to be resolved to blend the product).

Courtesy of EUMETSAT

Where to get the data?

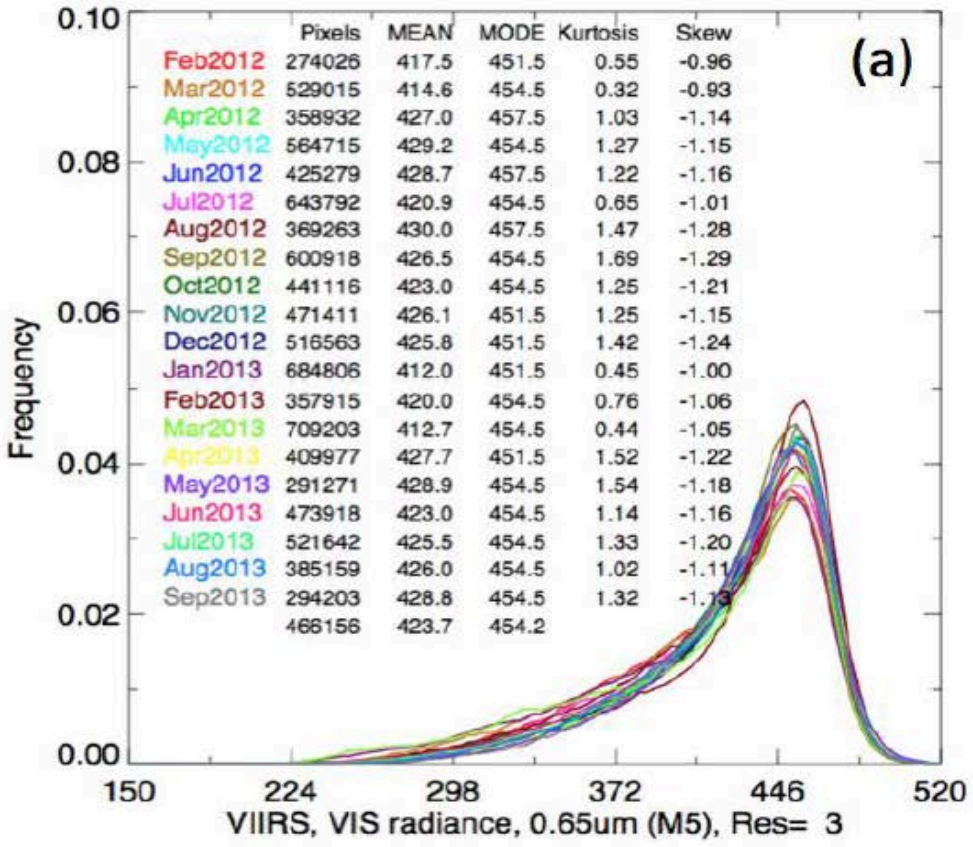
- NetCDF format
- Follows GSICS standards (based on WMO standards + CF conventions)
- Updated once per day (Near Real Time + Re-Analysis)
- A product user's manual soon available

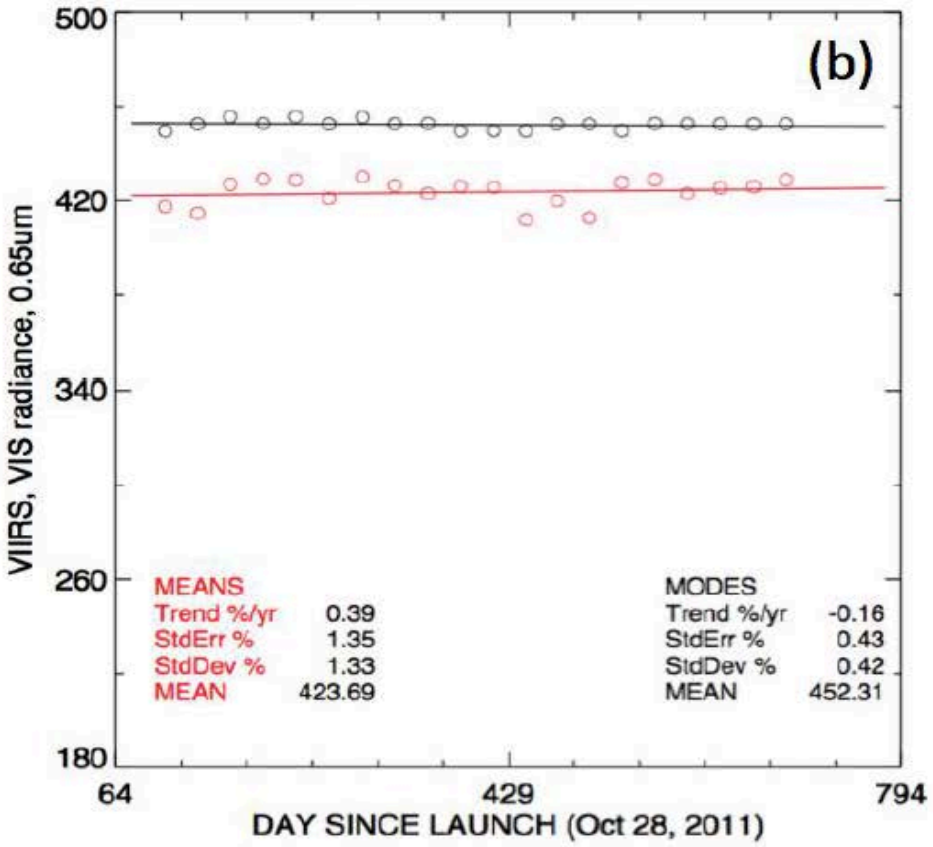
– For NRT + RA ➔ see http://gsics.eumetsat.int



Courtesy of EUMETSAT

VIIRS I1 (0.65µm) DCC mode radiances



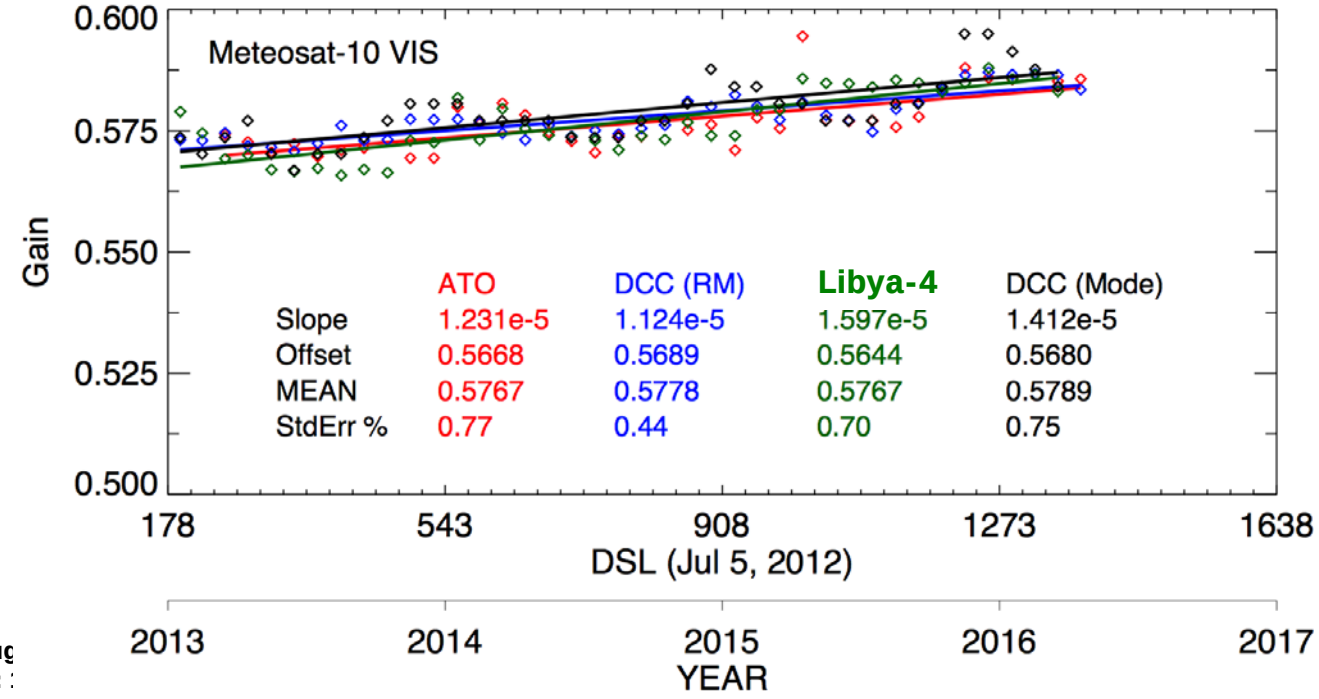


- **The VIIRS I1 band NASA LandPeate calibrated radiances seem stable over time**

GSICS Global Space-based Inter-Calibration System

Comparison of Met-10 VIS/NIR calibration methods

- Validate that the AquaMODIS DCC mode radiance equals the Meteosat-10 DCC mode radiance over the Met-10 domain
  - thereby validating that the DCC mode algorithm properly transfer the calibration reference
- Also all calibration methods are within 0.4%



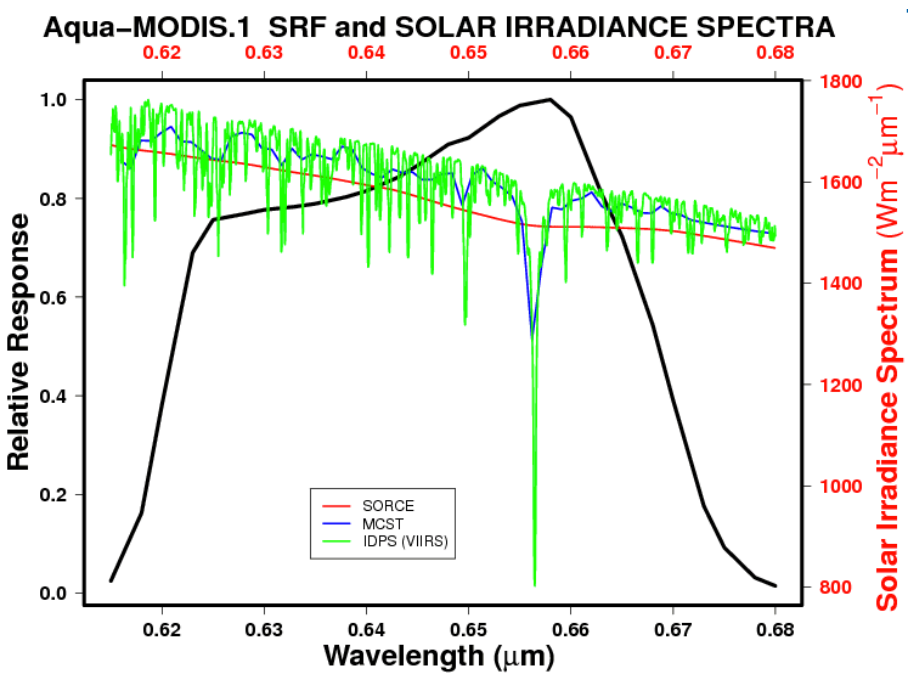
ATO: All-Sky Ocean Ray Matching
DCC (RM): DCC ray-matching
Libya-4: Based on Met-9 Libya-4 model
DCC (Mode): DCC mode radiance method (GSICS)

GSICS Global Space-based Inter-Calibration System

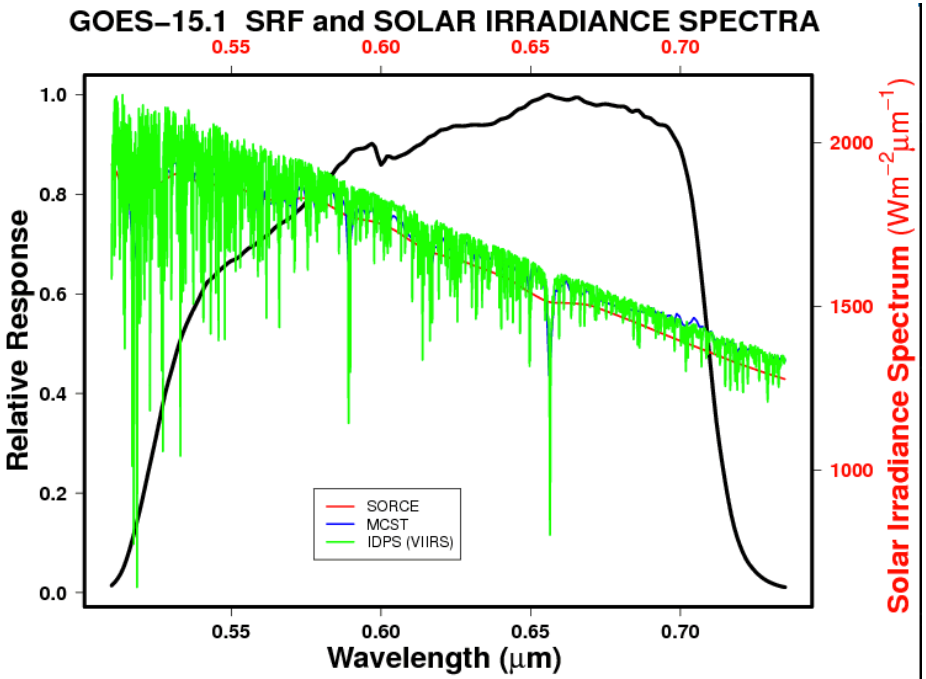
GSICS Solar Spectra Recommended Reference

- Many available solar spectra available
  - SORCE, daily varying
  - Thuillier, MCST, IDPS
  - Radiative transfer enhanced datasets
- Work with CEOS IVOS to recommend the best available solar spectra for the wavelength range needed
  - Spectral resolution
  - Absolute calibration
  - Work with Nigel Fox, Greg Kopp
- Have GSICS/CEOS IVOS web meeting, beginning this year

Solar Constant Comparison



Spectral Response File: Aqua-MODIS.1						
Solar Spectrum Reference	Band Center (micron)	Eqv. Width (microns)	Flux (W m-2)	IRRADIANCE (W m-2 um-1)	RADIANCE (W m-2 um-1 sr-1)	Solar Constant (Mean Sun-Earth Distance)
SORCE	0.64586	0.04249	66.59808	1567.53516	498.96191	1309.6921
MCST (MODIS)	0.64586	0.04248	67.96754	1600.12512	509.33563	1380.4011
IDPS (VIIRS)	0.64586	0.04249	67.76243	1594.93616	507.68393	1367.9952



Spectral Response File: GOES-15.1						
Solar Spectrum Reference	Band Center (micron)	Eqv. Width (microns)	Flux (W m-2)	IRRADIANCE (W m-2 um-1)	RADIANCE (W m-2 um-1 sr-1)	Solar Constant (Mean Sun-Earth Distance)
SORCE	0.62486	0.16023	262.75290	1639.87915	521.98975	1309.6921
MCST (MODIS)	0.62486	0.16023	266.65323	1664.22668	529.73981	1380.4011
IDPS (VIIRS)	0.62486	0.16023	267.11227	1667.08032	530.64813	1367.9952

- Absolute calibration within 1.7%

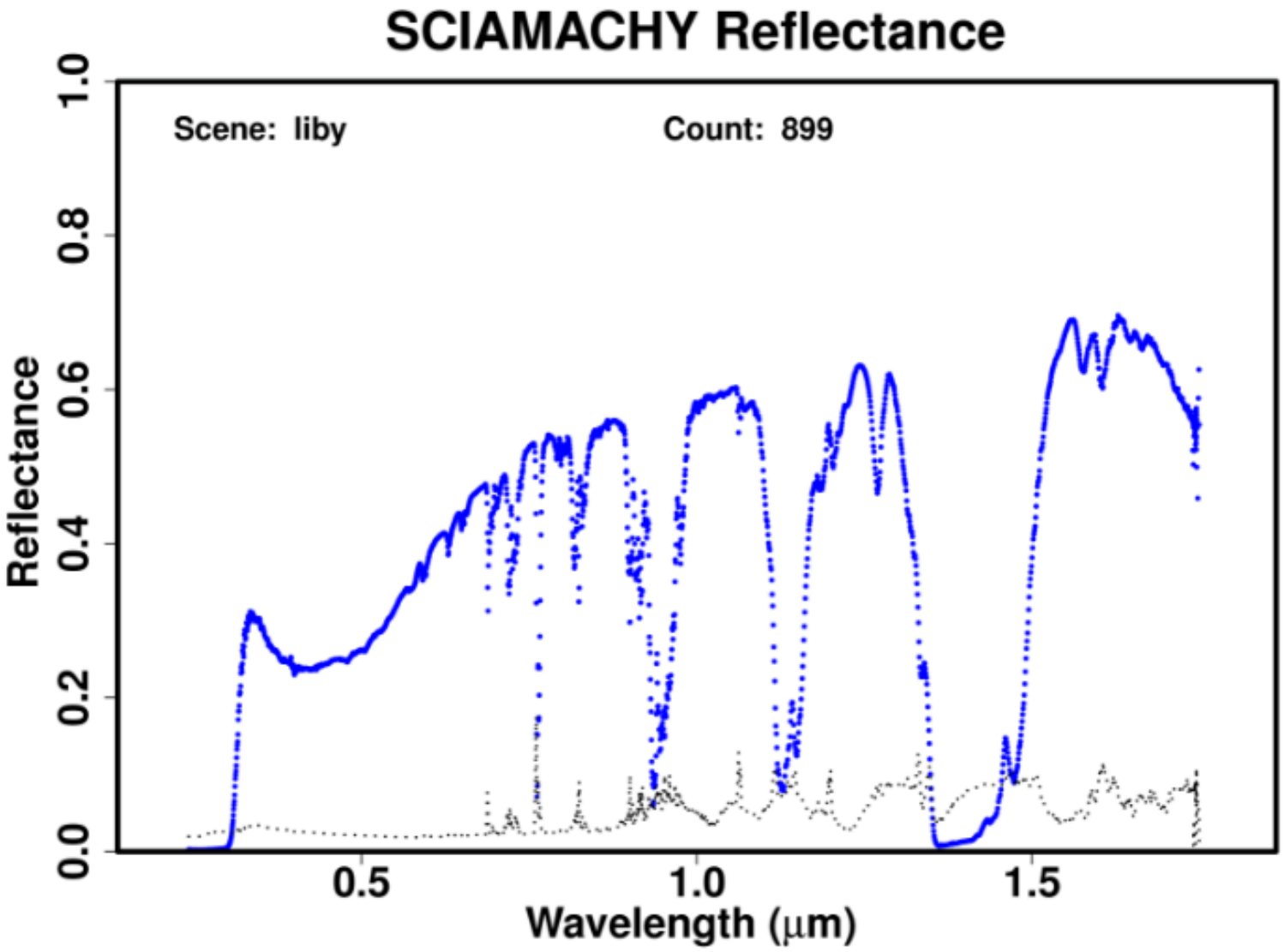
* When using the same solar spectra dataset, the band ratios are very consistent

GSICS Global Space-based Inter-Calibration System

Spectral Band Adjustment Factor (SBAF)

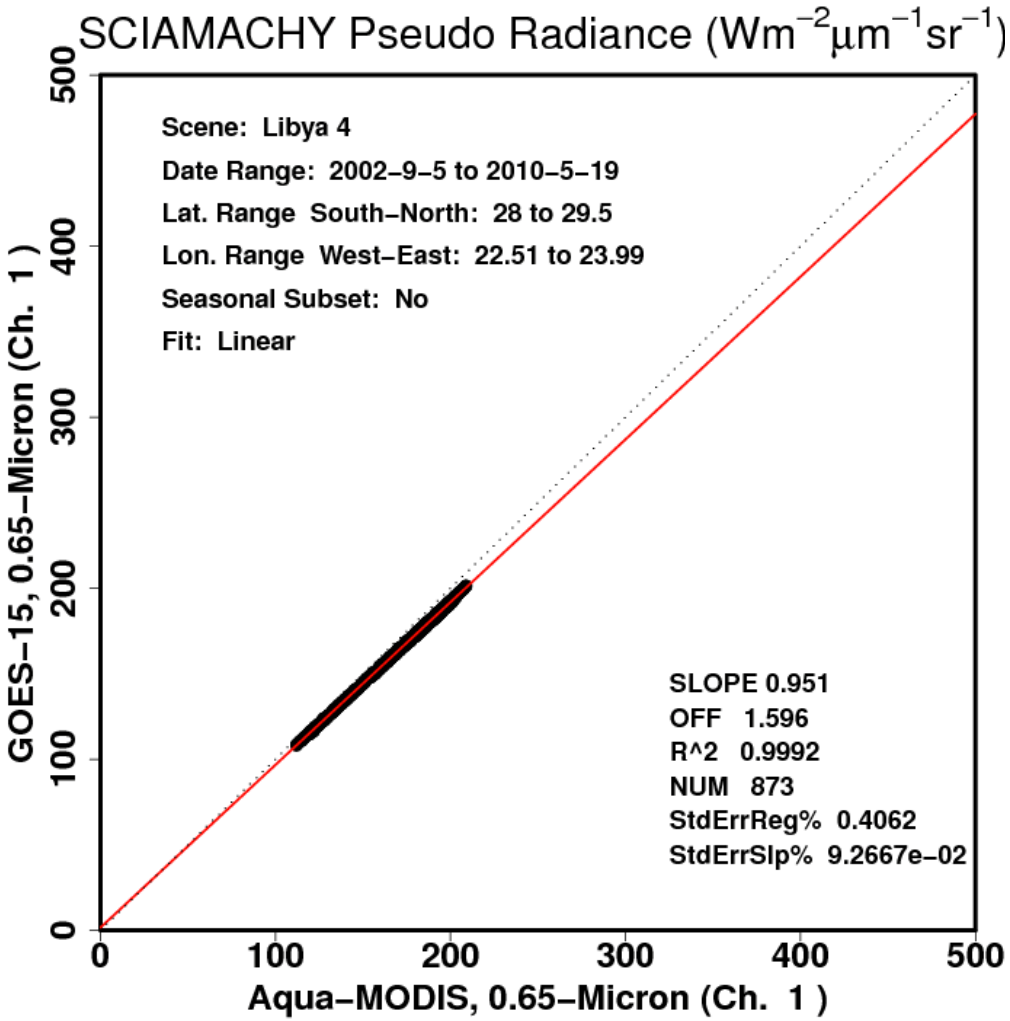
- Web site available for SBAF over many SCIAMACHY based Earth reflected spectra
  - http://www-pm.larc.nasa.gov/cgi-bin/site/showdoc?mnemonic=SBAF
- Future Plans
  - Incorporate Hyperion, and GOME-2 observations

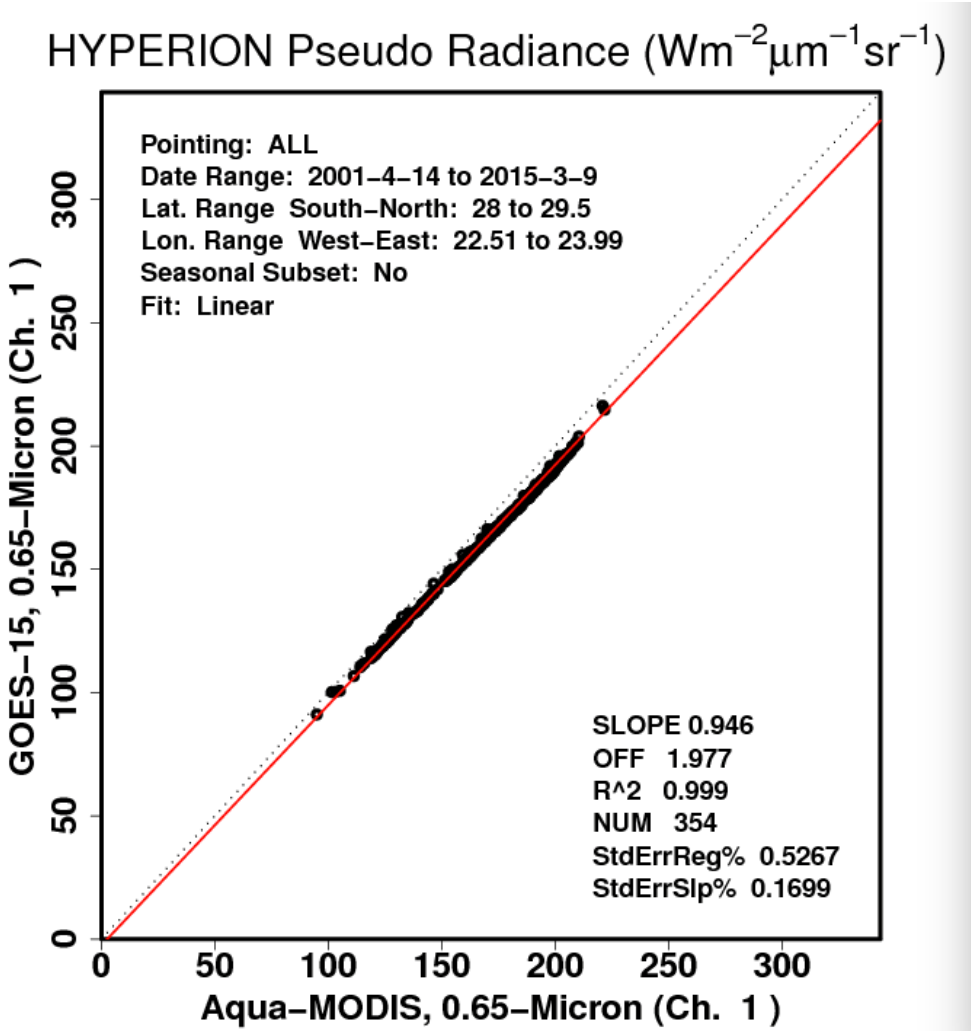
Libya-4 SCIAMACHY spectra



GSICS Global Space-based Inter-Calibration System

Comparison of SBAF over Libya-4





Global Space-based Inter-Calibration System

Thank You
Any thoughts for Discussion