2022

GSICS Executive Panel report to CGMS plenary

Presented to CGMS-52 plenary, agenda item CGMS-52-GSICS-WP-01p

Dr. Bojan R. Bojkov (EUMETSAT), GSICS EP Chair

Coordination Group for Meteorological Satellites

CGMS

Recent Global Space-based Inter-calibration System activities

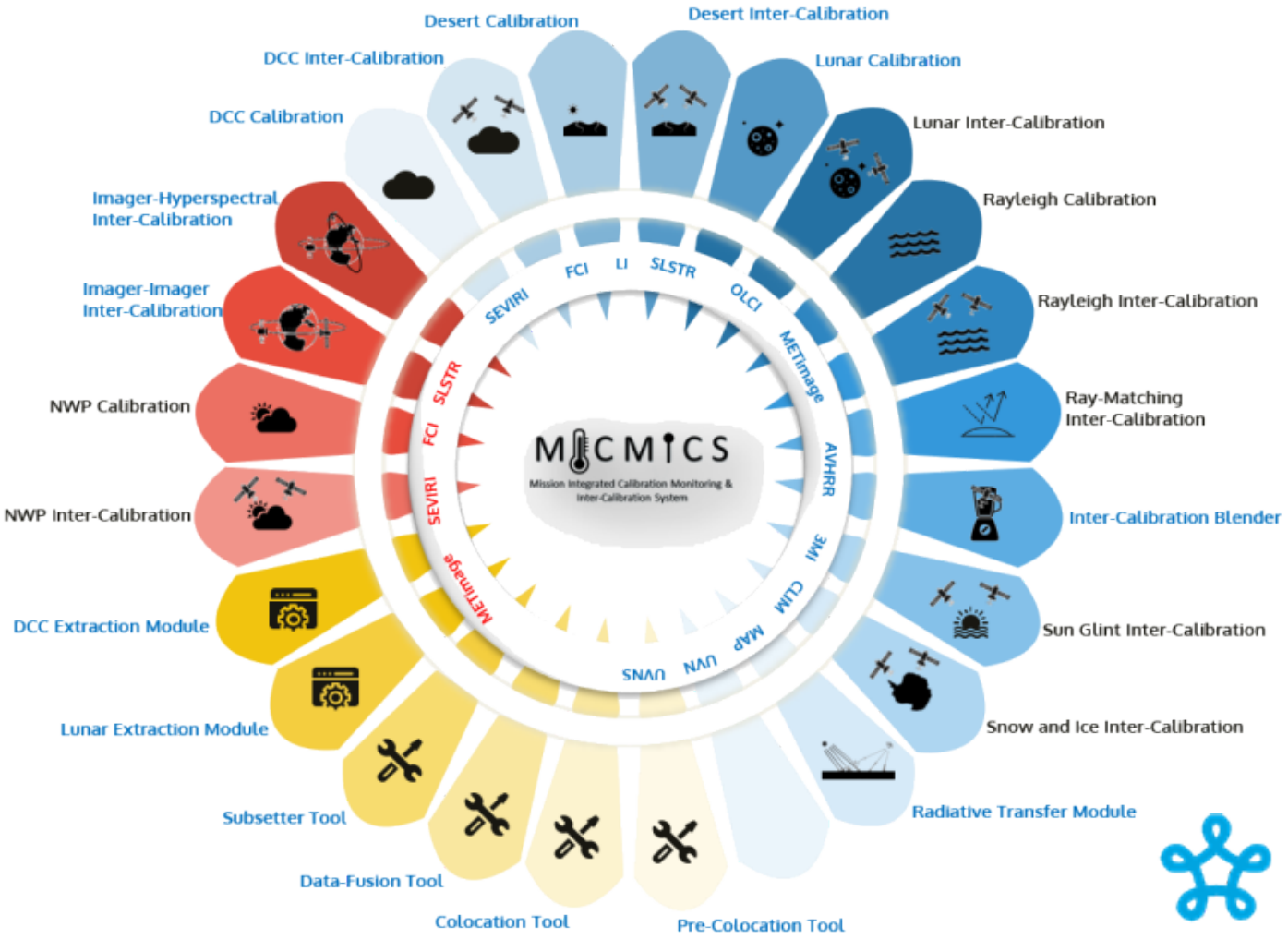
- The annual meeting of the Global Space-based Inter-Calibration System (GSICS) took place at EUMETSAT HQ from 11 to 15 March:
  - 60+ participants from operational and R&D space agencies took part, including representatives from commercial companies
  - In addition to the GSICS working sub-group meetings, two plenary sessions were organised to address specific topics, for example lunar calibration, polarimeters, microwave calibration, commercial data challenges, etc.
- New this year:
  - The first in person Space Weather subgroup meeting took place during the annual meeting
  - The Executive Panel (GSICS EP) took place in conjunction with the annual meeting

Coordination Group for Meteorological Satellites

CGMS

Highlights: GSICS achievement wrt level-1 monitoring

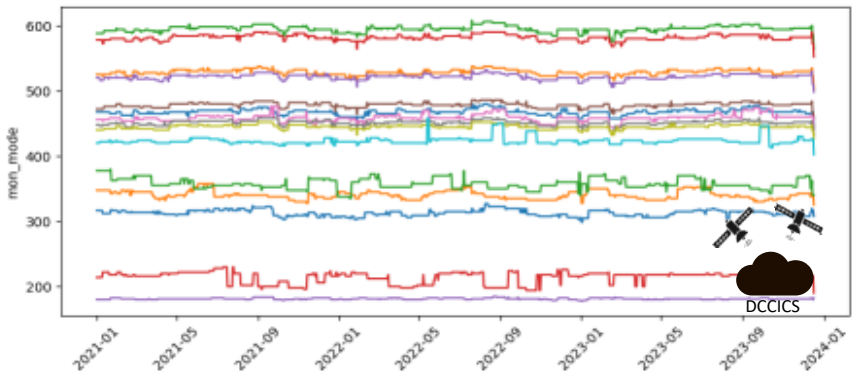
- GSICS tools and SOPs implementations at EUMETSAT (MICMICS tool, right)
- Combination of 10+ years of GSICS efforts and developments
- Operational monitoring in place at EUMETSAT for MSG/Seviri, Sentinel-3 optical, MTG/FCI



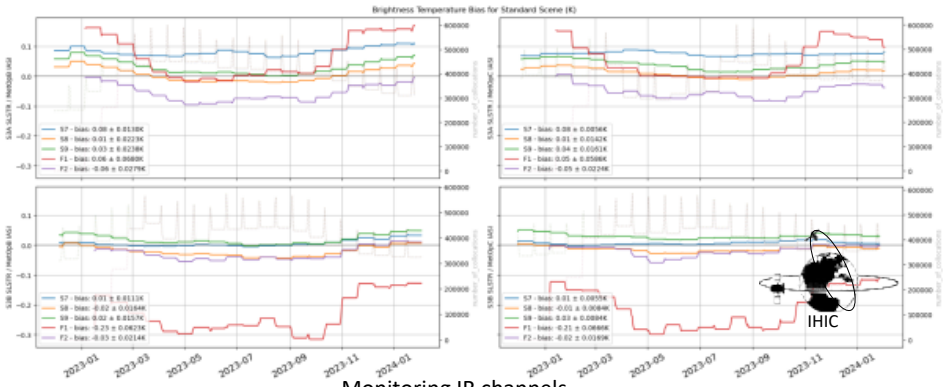
Coordination Group for Meteorological Satellites

CGMS

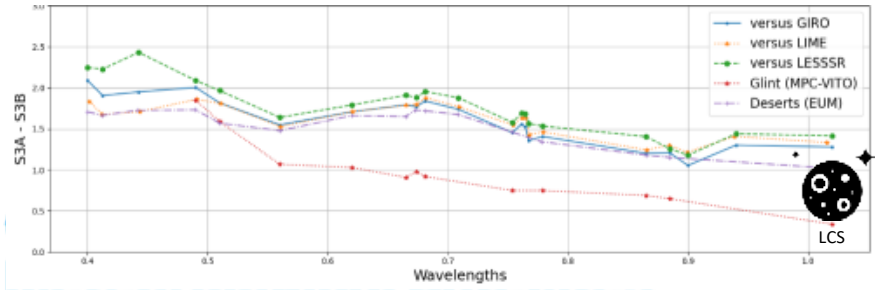
Ex: MICMICS for Sentinel-3



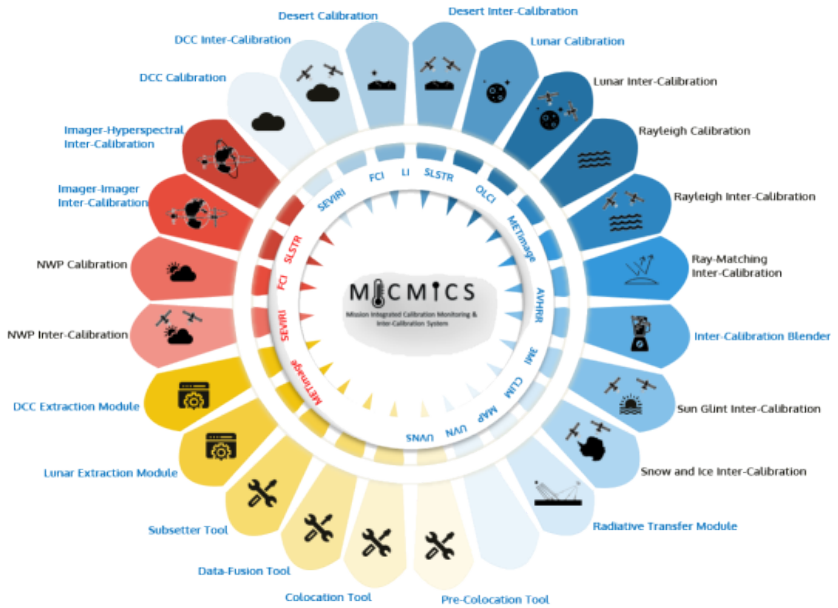
VNIR Drift monitoring

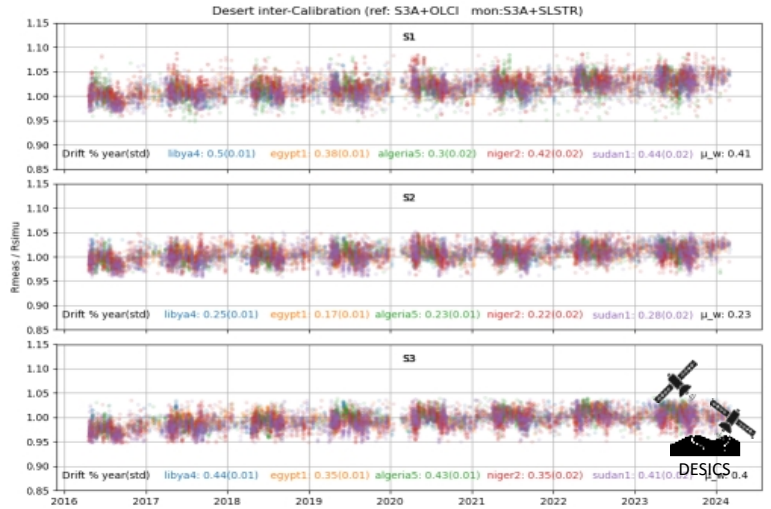


Monitoring IR channels

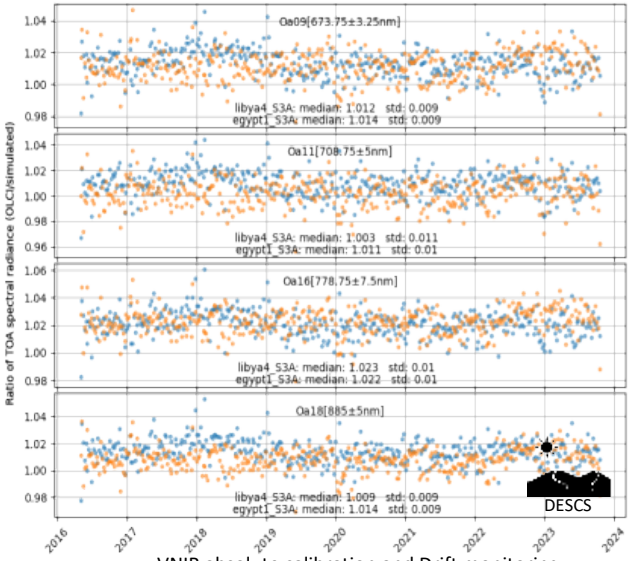


S3A-OLCI vs S3B-OLCI difference from various calibration and inter-calibration systems

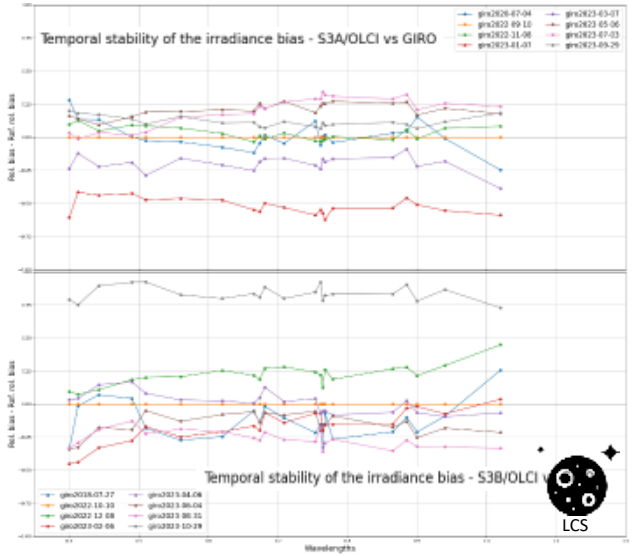




VNIR Drift monitoring



VNIR absolute calibration and Drift monitoring

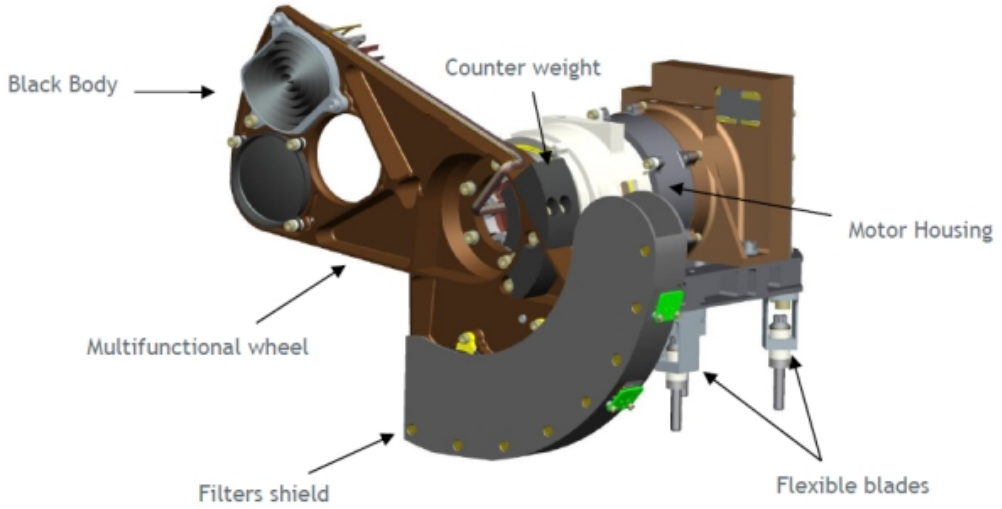


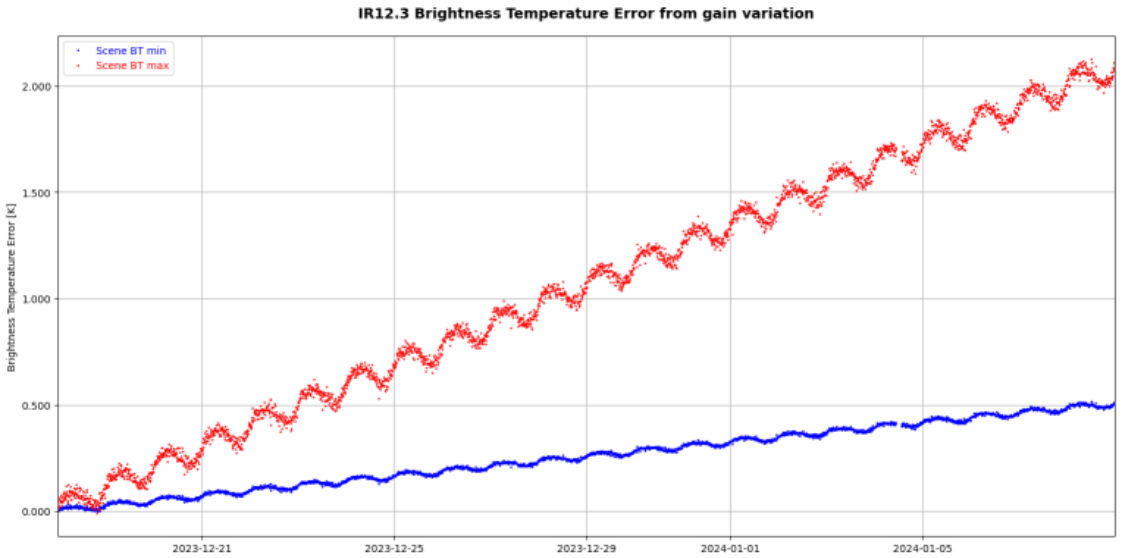
VNIR Drift monitoring

Use of MICMICS for MTG/FCI calibration

- MTG/FCI has a problem with the Calibration and Obturation Mechanism (COM) which does not allow for the use of the blackbody for the IR channels, resulting in rapid degradation (stripes in the images, loss of absolute radiometric accuracy, loss of radiometric stability).

- **Background:** Due to the ice layer building up on the detectors plate, the instrument's response is varying, and it is not compensated by the blackbody calibration any longer → For some channels, this will lead to a drift of the measured BT and errors up to ~2K/month, especially 10.5, 12.3, 13.3 (the drift for all the other channels is slower).



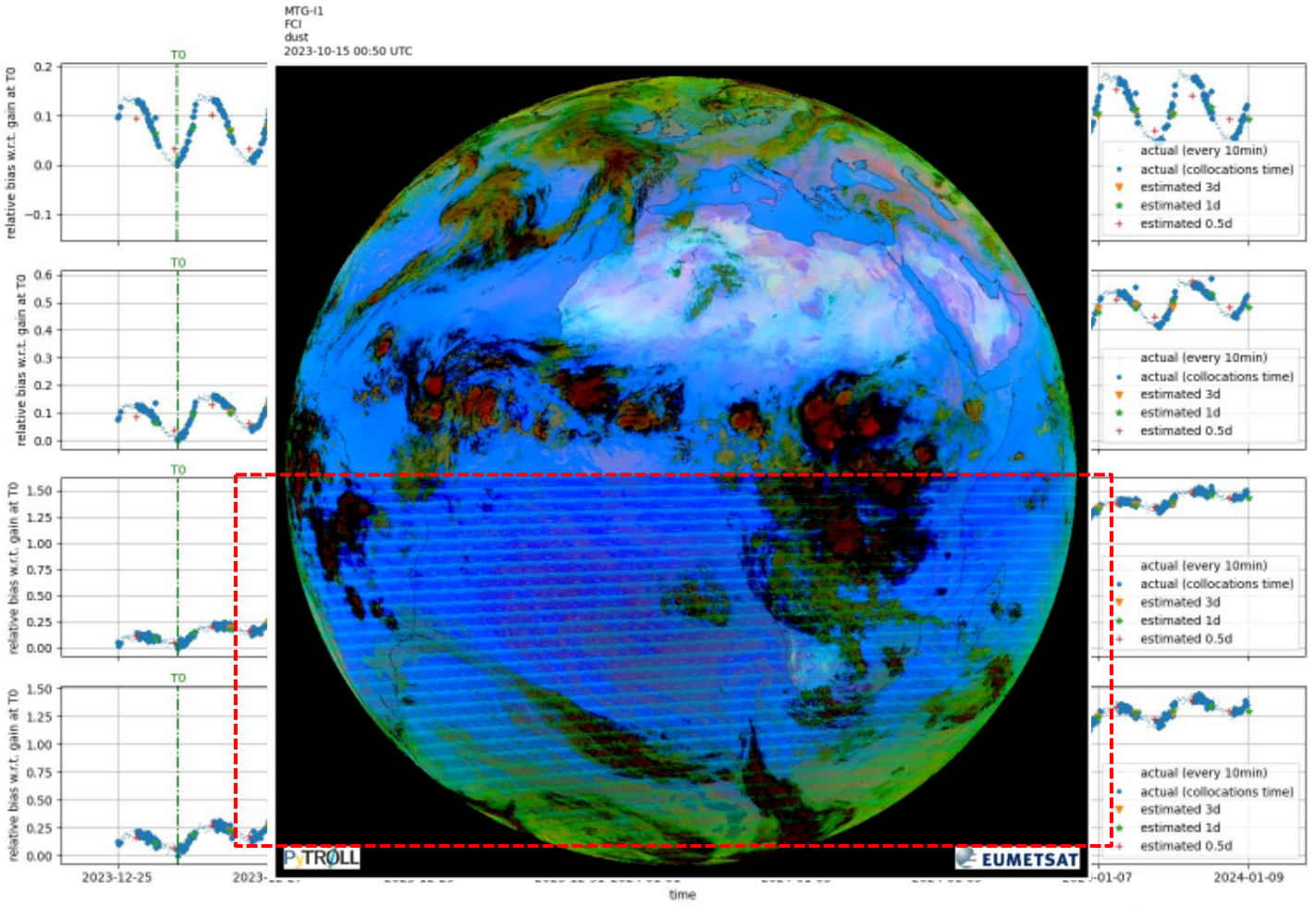


Coordination Group for Meteorological Satellites

Use of MICMICS for MTG/FCI calibration (ii)

Mitigation: By means of the EUMETSAT MICMICS tools, it is possible to retrieve the IR gains with acceptable accuracy and to compensate for the IR channels degradation:

- Use of IASI as a reference instrument to retrieve the absolute average calibration by collocating IASI and FCI in time and space.
- Statistical derivation of the average gains per channel
- Quality filtering of retrieved gains
- Creation of synthetic BB measurement file to be fed into the IDPF (daily)
- Production of synthetically calibrated L1C FCI data



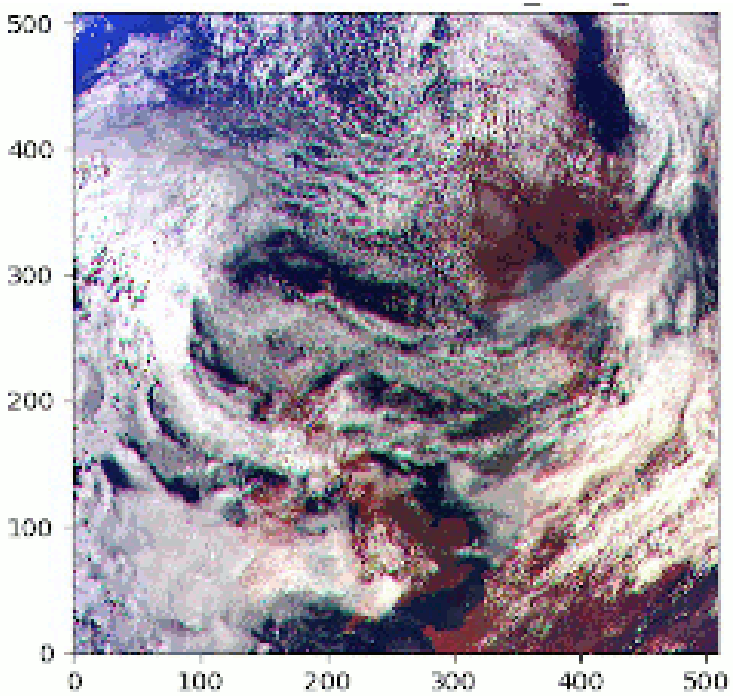
Coordination Group for Meteorological Satellites

CGMS

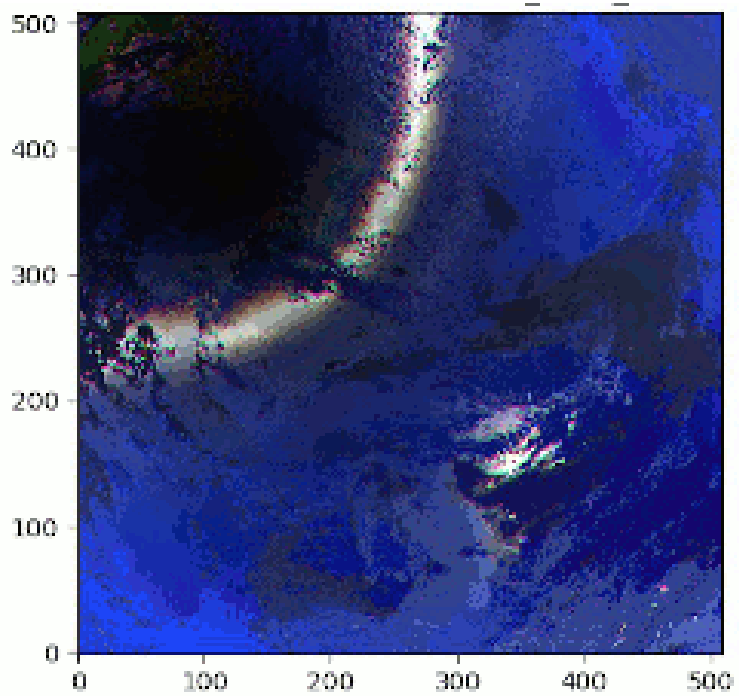
Polarisation – *a different vision of the Earth-Atmosphere*

Level 1 TOA reflectance (RGB)

Natural light



Polarized light



3MI simulated observation

R=865nm
G=670nm
B=443nm

Coordination Group for Meteorological Satellites

CGMS

Polarimeters

- Numerous polarimeters are in orbit or are up and coming (including commercial)
- Extremely useful for atmospheric composition (aerosols properties) and high potential for marine parameter retrievals (ocean colour related)
- Calibration of polarimeters (ground and in flight) is extremely challenging and has a direct impact on level-2 product inter-operability

Instrument	*Platform*	*Status*	*Agency*
GOME-2	Metop-B&-C	flying	EUMETSAT
CAPI	TanSat	flying	china
GCOM-C	S-GLI	flying	JAXA
DPC	GF-5	flying	CNSA-CAS
S-GLI	GCOM-C	flying	JAXA
DPC	GF-5-2	flying	CNSA-CAS
DPC	GF-5-01a	flying	CNSA-CAS
DPC-2	DQ-1	flying	CNSA-CAS
HARP	CubeSat	flying	UMBC
POSP	HJ-2	flying	china
SMAC	HRMIS	flying	CAST
GAPMAP	Cubesat	flying	GAP
HARP2	PACE	2024	UMBC
SpexOne	PACE	2024	SRON-NASA
DPC-2	DQ-2	2025	CNSA-CAS
3MI	EPS-SG	2025	EUMETSAT
MAIA	OTB-2	2025	NASA
ScanPol	Aerosol-UA	coming	MAO
MSIP	Aerosol-UA	coming	MAO
MAP	CO2M	2026	Copernicus
Polarimeter	AOS-P	2029	NASA

Non-exhaustive list (Dubovik et al, 2019; WMO-OSCAR database)

Coordination Group for Meteorological Satellites

Polarimeters – *way forward in GSICS*

- Polarimeter related activities need special consideration within GSICS
  - Discuss a set of common references and/or methodologies/best practises
  - Selection of RTM, PICS reference BPDF, lunar polarisation models
  - Moving toward intercalibration of the polarisation
  - Special role for polariser equipped with on-board polarisation calibration systems
  - Identify if best practices can be implemented as GSICS references for operational missions

- Short-term: organise a dedicated workshop to be organised with targeted experts
  - Exhaustive brainstorming on in-flight approaches
  - Three needs: Evaluation of performance (commissioning); Monitoring; and Inter-calibration assessment
  - Outcome: recommendations for developments, best practices, and implementations

- Due to commonalities with optical VisNIR systems, polarimeter activities are well placed under the GRWG VisNIR sub-group

Coordination Group for Meteorological Satellites

CGMS

Passive Microwave Intercalibration

- With the advent of hybrid constellations (instrumental, orbital, as well as commercial) and the end-user need of consistent level-1 data for applications (e.g. NWP, IPWG requirements), establishing effective passive microwave intercalibration across missions has become pressing
- GSICS has initiating a dedicated MW sub-group activity to investigate and develop monitoring tools for microwave constellations following the GRWG VisNIR tools model (see MICMICS)
- Progress and highlights will be reported on in the next CGMS meetings

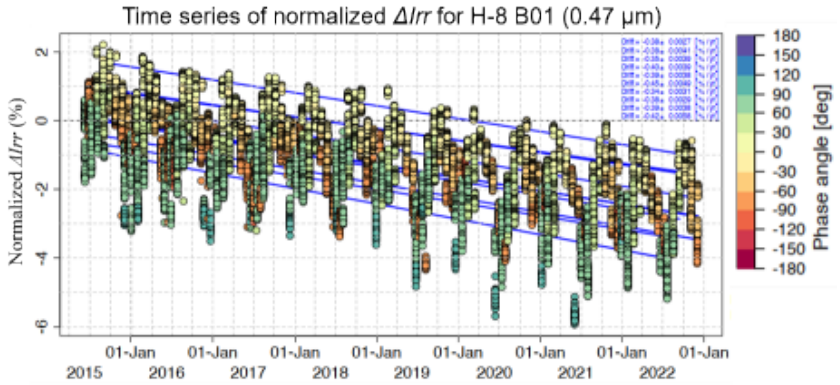
Coordination Group for Meteorological Satellites

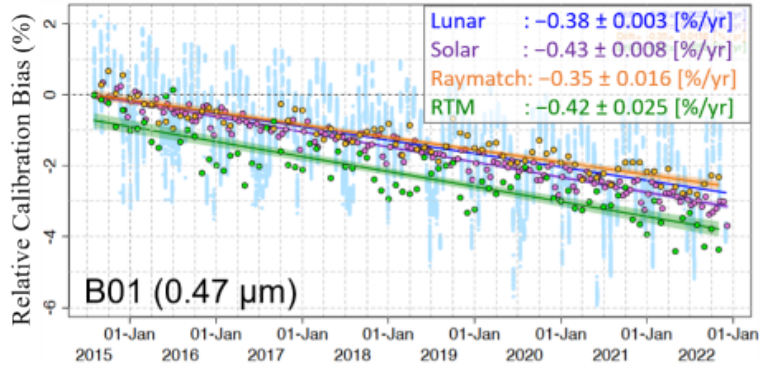
CGMS

Lunar calibration elevated to a GSICS cross-cutting activity

Lunar Calibration = widely used among GSICS and CEOS members for monitoring mission radiometric performances. Ex. JMA has made ~30,000 Moon observations over 7.5 years!

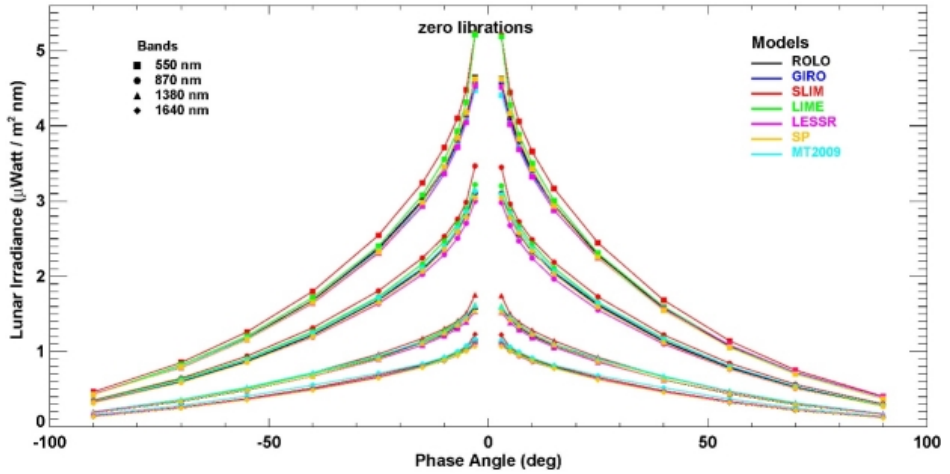
Phase Angle Range [deg]	Trend Estimation (95% Conf. Intvl) [%/yr]
[-92, 92]	-0.38 (±0.0027)
[70, 90]	-0.45 (±0.0049)
[50, 70]	-0.39 (±0.0038)
[30, 50]	-0.40 (±0.0039)
[10, 30]	-0.35 (±0.0039)
[-10, 10]	-0.38 (±0.0041)
[-30, -10]	-0.34 (±0.0031)
[-50, -30]	-0.38 (±0.0029)
[-70, -50]	-0.39 (±0.0038)
[-90, -70]	-0.42 (±0.0058)





GSICS is leading a lunar model inter-comparison exercise

- Goal = to understand the differences between lunar models
- Current reference = USGS ROLO model
- It will help reducing the uncertainties while monitoring the instrument drift



Coordination Group for Meteorological Satellites

CGMS

GRWG Space Weather SG

- Formally established in December 2022 → first in person meeting was held during the 2024 GSICS annual meeting

- Work plan/Priorities as of March 2024:
  - Initially focus on high-energy particle sensors on GEO
  - Proposing application produced from multiple satellite data
  - Proposing method of near-real time and archival inter-calibration
  - Harmonizing data levels
  - Defining GSICS products and tools for space weather sensor

- Reporting on the SG progress to come in the next CGMS meetings

Coordination Group for Meteorological Satellites

CGMS

Summary

- GSICS is very active, productive, and growing in interest/participation across space organisations
- GSICS tools are key for the monitoring and interoperability of the global observing system → standardised reporting of performances by agencies is key for usability (GDWG to report on way forward this year)
- GSICS tools, as implemented in MICMICS for example, can help characterise a mission with significant calibration issues
- GSICS developed best practises and tools are being implemented, with modifications, across new instrument areas such a microwave constellations, polarimeters, lunar model characterisation
- The newly Space Weather sub-group started its work within GSICS over the last year
- The GSICS EP to be held in conjunction with the annual meeting from now on (carbon footprint)

Coordination Group for Meteorological Satellites

CGMS