Highlights from the
17th Executive Panel Meeting

Kenneth HOLMLUND (GSICS-EP Vice-Chair)

Outline

1. GSICS purpose and organization

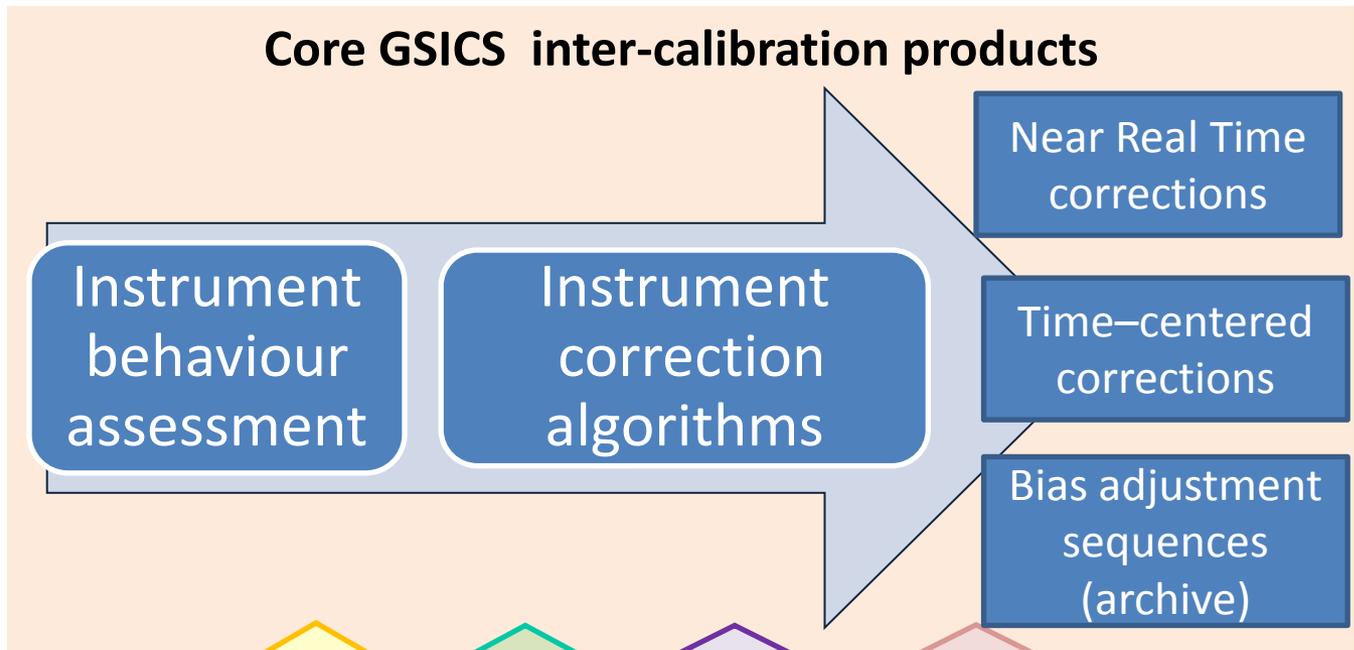2. Highlights of recent activities

3. Recommendations

Why GSICS?

- Space-based observations from various satellite missions and agencies must be precisely calibrated with similar methods against common references to be reliable and interoperable.

- Poor or inhomogeneous calibration results in degraded performance and lower benefits

- **CGMS members are collaborating within GSICS to develop and apply "best practices" for homogeneous calibration**

- **GSICS provides**: references, guidelines, methodologies and tools enabling satellite operators to evaluate and improve their calibration and to deliver intercalibration adjustments (*GSICS Corrections*).
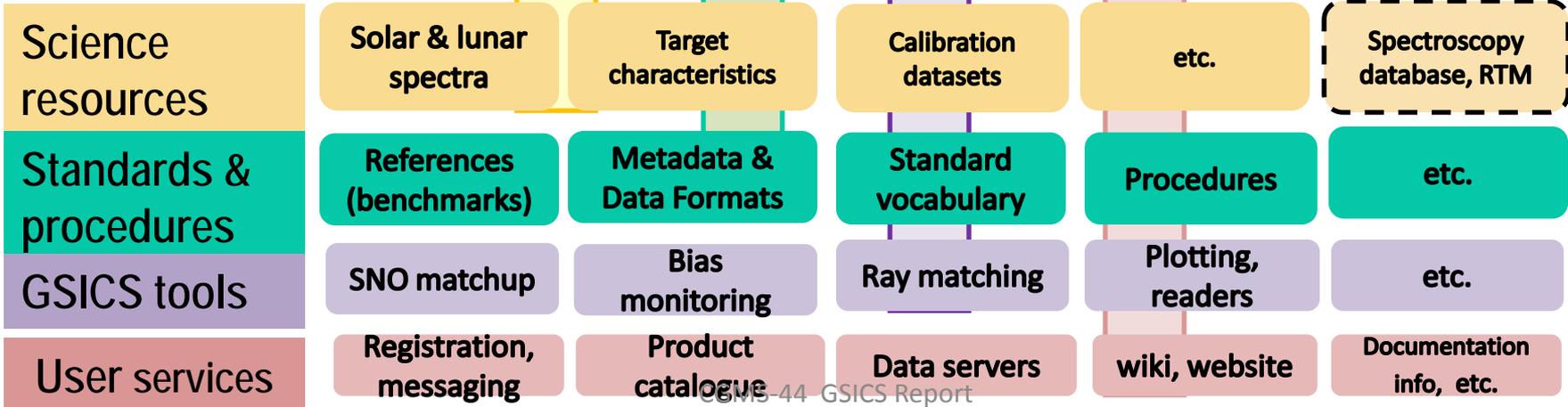
GSICS deliverables

Core GSICS inter-calibration products

Monitored instrument

Instrument behaviour assessment

Instrument correction algorithms

Near Real Time corrections

Time–centered corrections

Bias adjustment sequences (archive)

Users

|				
Science resources	Solar & lunar spectra	Target characteristics	Calibration datasets	etc.	Spectroscopy database, RTM
Standards & procedures	References (benchmarks)	Metadata & Data Formats	Standard vocabulary	Procedures	etc.
GSICS tools	SNO matchup	Bias monitoring	Ray matching	Plotting, readers	etc.
User services	Registration, messaging	Product catalogue	Data servers	wiki, website	Documentation info, etc.

Who benefits from GSICS ?

- **Satellite operators participating in GSICS**
  - Sharing development effort and resources (calibration references, datasets, software tools)
  - Capacity building (best practices for instrument monitoring, traceability, sensor comparison and correction)
  - Improved instrument assessment, faster identification and correction of anomalies, facilitating commissioning and operation
  - Interoperability within the CGMS constellation,

- **Satellite data users**
  - Improved calibration
  - Interoperability through inter-calibration
  - Assessments, reports, for better understanding
  - Algorithms enabling to reprocess data records

  - ➢ GSICS leverages the value of individual missions

GSICS Structure
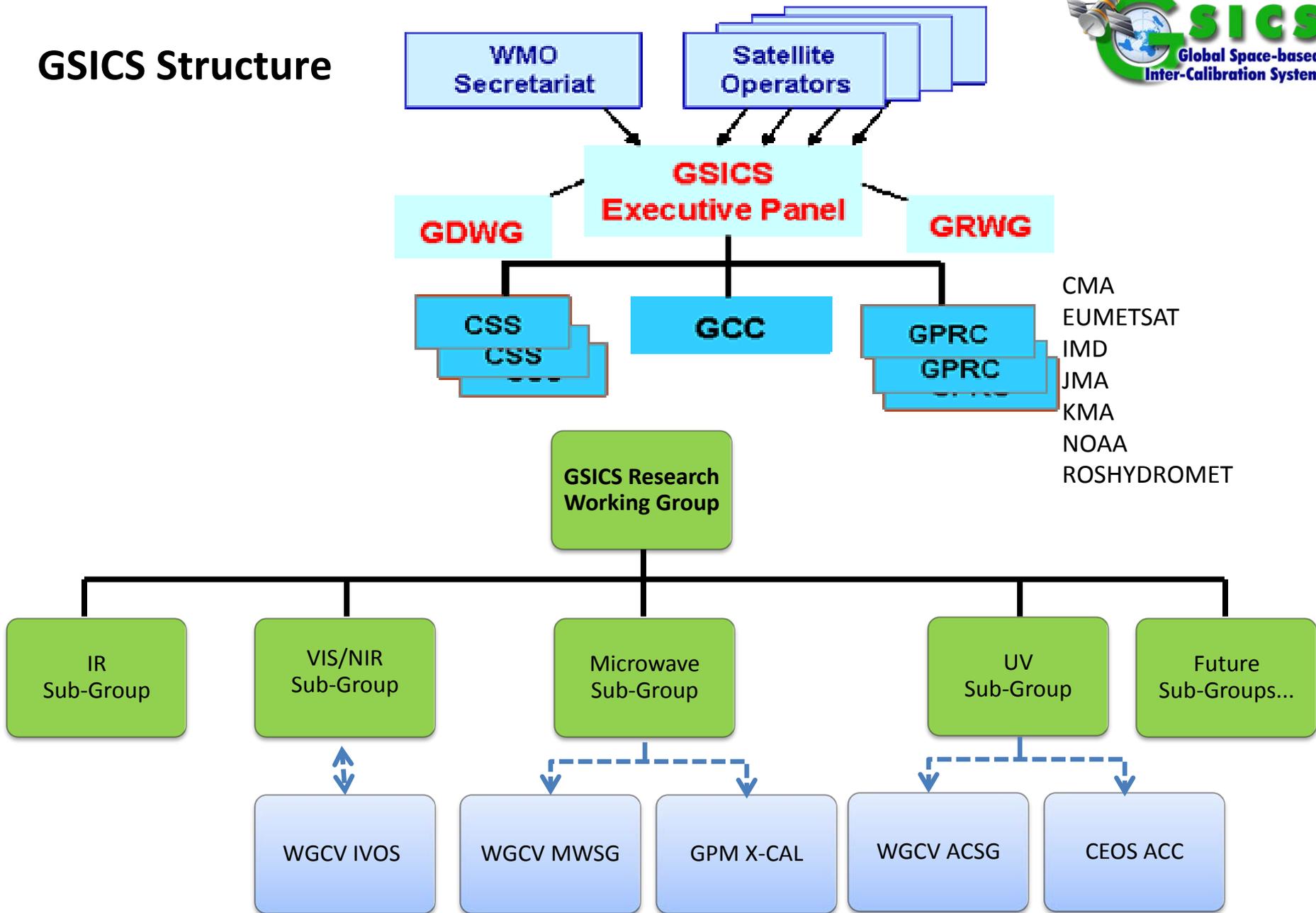
CGMS-44 GSICS Report

Outline

1. GSICS purpose and organization

2. **Highlights of recent activities**

3. Recommendations

GCC Highlights

- **GSICS Coordination Center continues to support and coordinate exchanges of ideas within GSICS.**

- **Review of MSG-2,-3/IASI-A products was completed and Products are in Operational Status.**

- **Review of DCC and Prime product completed at GPPA.**

- **List of GCC focused discussions at this meeting**
  - **Promotion of products to pre-operational or operational stage**
  - **Status of GSICS User Requirements and discussion**
  - **Catalogue and definition of GSICS deliverables**
  - **GSICS documentation and outreach**

GSICS GEO-LEO IR Product Status 2016-02 (IR)

GPRC	Monitored Instrument	Reference Instrument	GSICS NRT Correction	GSICS Re-Analysis Correction	GSICS Bias Monitoring
EUMETSAT	Meteosat-9, -10* Meteosat-7	Metop-A/IASI*	Operational Demo	Operational Demo	Plots RAC*
JMA	MTSAT-1R } MTSAT-2 }	IASI (+ AIRS)	Demo	Demo	Plots RAC
NOAA	GOES-13 & -15 Imager GOES-11 & -12 Imager	IASI (+ AIRS)	Pre-op	Pre-op Demo	Prototype
	GOES Sounder	IASI (+ AIRS)	Development	Development	In development
CMA	FY2C – E	IASI (+ AIRS)	Development	Development	Prototype
KMA	COMS-1	IASI	Prototype	Prototype	
ISRO	INSAT-3D	IASI	Prototype	Prototype	

For the first time we will be able to inter-calibrate the geostationary ring to the same reference!

Near-term GCC Goals for 2016-2017

- Evolution of the GSICS Procedure for Product Acceptance
  - *Support inclusion of New Products*
- Coordination
  - *Continue to coordinate efforts to establish the GSICS baseline algorithms, especially those for the GEO solar reflective channels,*
  - *Continue to provide communication between the developing group and users*
- Publish the GSICS Quarterly Newsletter
  - Continue to create and distribute this important link to the GSICS community.
- Support Reviews of GSICS Products, Deliverables and Resources
- Meeting Support
  - *Joint Meeting, GSICS Web Meetings and QA4EO telcons.*
  - *Organization of GSICS 7th Users Workshop at NCWCP, USA*
- Gather more user requirements

Outreach

- A user survey was performed with in order to improve services:-> To be followed-up by the WGs

- CEOS WGCV plenary 5-7.9. Tokyo

- GSICSWiki.net

- GHRSST using IASI CrIS and AHI!!

Engaging with users

- Invitation to GHRSST to evaluate the impact of GSICS corrections on AHI data for SST retrieval
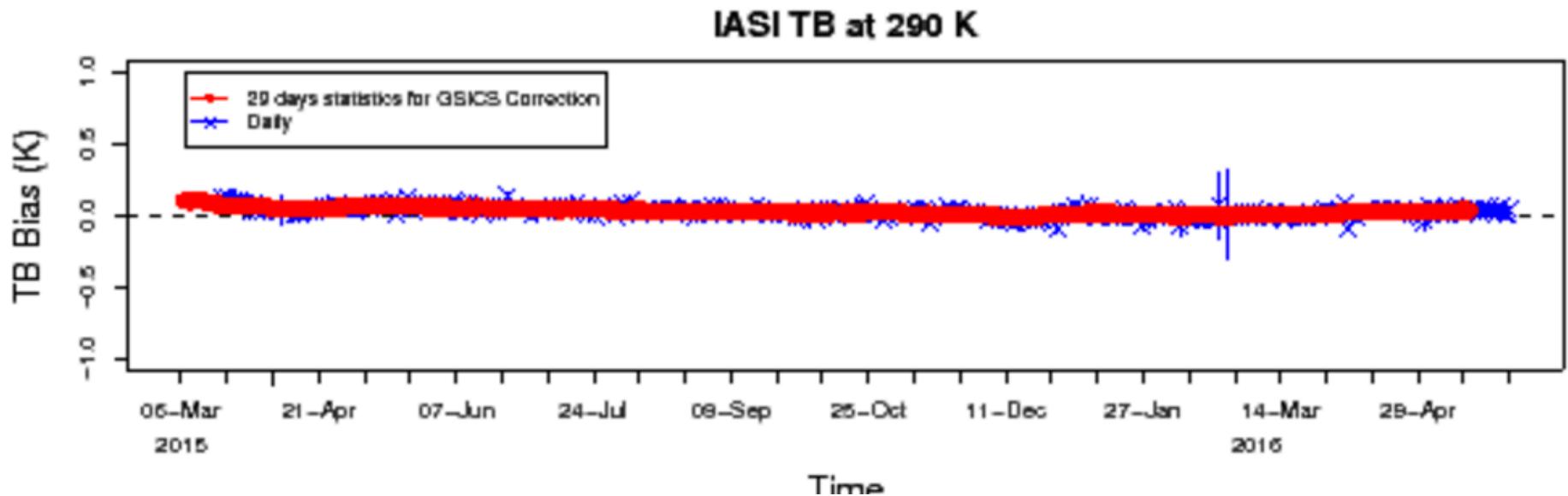
Overall GSICS Coordination Issues
Near-term goals for GSICS Coordination Center

- **Keep coordinating the product acceptance process**
  - Bring more products to pre-ops and operational stage
  - Streamline communication with EP to speed up the procedure
- **Complete Review of GSICS Deliverables**
  - Define relevant acceptance procedure for new deliverables
  - Expand catalogue (or equivalent) for new deliverables
  - Complete draft Guide to GSICS Products and Services
- **Gather more, and more detailed, user requirements**
  - Including from climate community
- **Support communication with users and developers**
  - Continue publishing the GSICS Quarterly Newsletter
  - Support Joint meeting, web meetings,
  - Prepare7[th] Users workshop

GSICS Reference Documents

- **Introduction to GSICS (Draft under review)**
- **Vision of GSICS (published)**
- **Terms of Reference (Published)**
- **Guide to GSICS Products and Services (draft in progress)**

- To promote shared vision among GSICS members
- For more visibility, and external recognition of GSICS, e.g. within WIGOS and within the Architecture for Climate Monitoring from Space

Product Endorsement Process

- Process including required documentation agreed

- Approach for Families of instruments agreed

- Reference instrument discussion
  - Set of reference instruments exist and the agencies are hence encouraged to implement operational product for all references
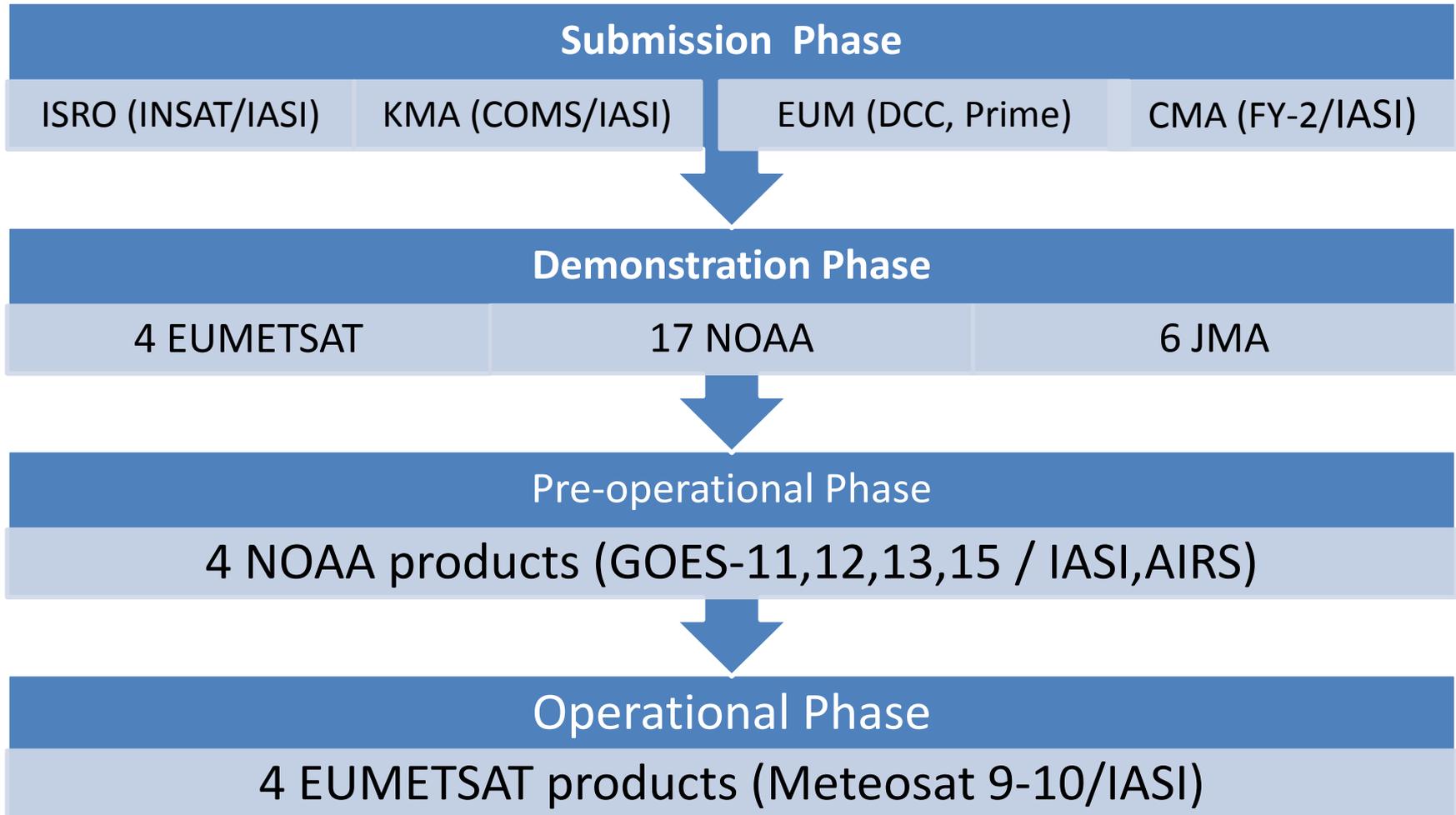
Responding to CGMS HLPP Targets

3.1 Establish a fully consistent calibration of relevant satellite instruments across CGMS agencies, recognizing the importance of collaboration between operational and research CGMS agencies;

- Establish within GSICS a consistent inter-calibration for **thermal IR channels using hyper-spectral sounders as reference**. The implementation will be done successively by the individual satellite operators.

- Establish within GSICS a consistent inter-calibration for **solar channels using instruments with adequate in-orbit calibration and vicarious methods as reference**. The implementation will be done successively by the individual satellite operators.
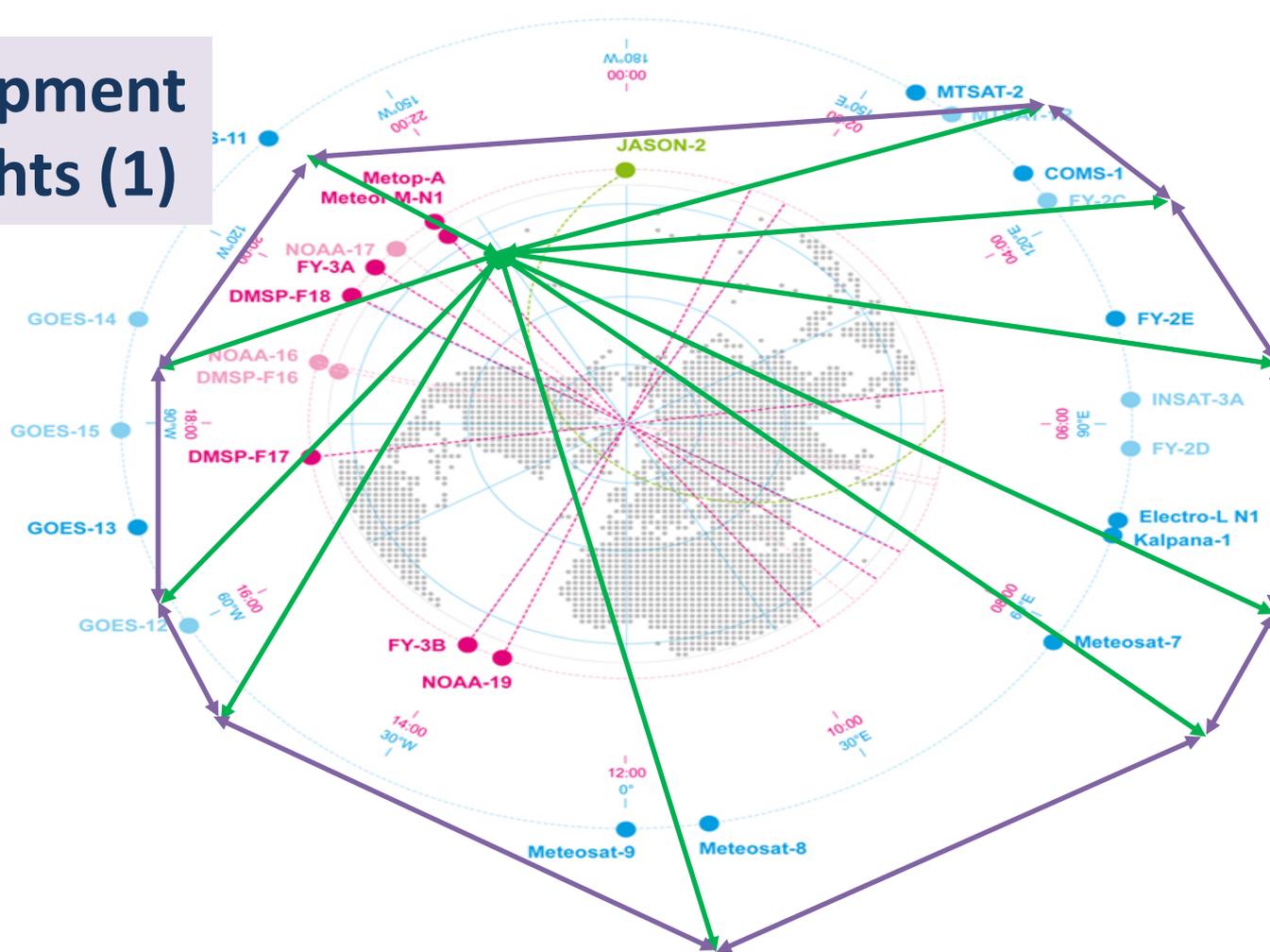
Status of CGMS HLPP Targets

- IR is currently being performed by most agencies operating geostationary imagers – albeit at different levels of maturity. Operational for 2 satellites (+4 in pre-ops stage).The algorithm is also being rolled out to LEO platforms by some agencies. So not yet "fully achieved" – however roughly 90% achieved

- VIS/NIR is still in development, with the first demonstration GSICS products for the VIS channel of geostationary imagers, based on Deep Convective Clouds, and referenced to MODIS to start in 2016. Counterpart products for other satellites will follow. The algorithm will then be extended to include the Moon as a calibration transfer, which is also applicable to channels in the NIR. Roughly 50% achieved

Operational coordination:
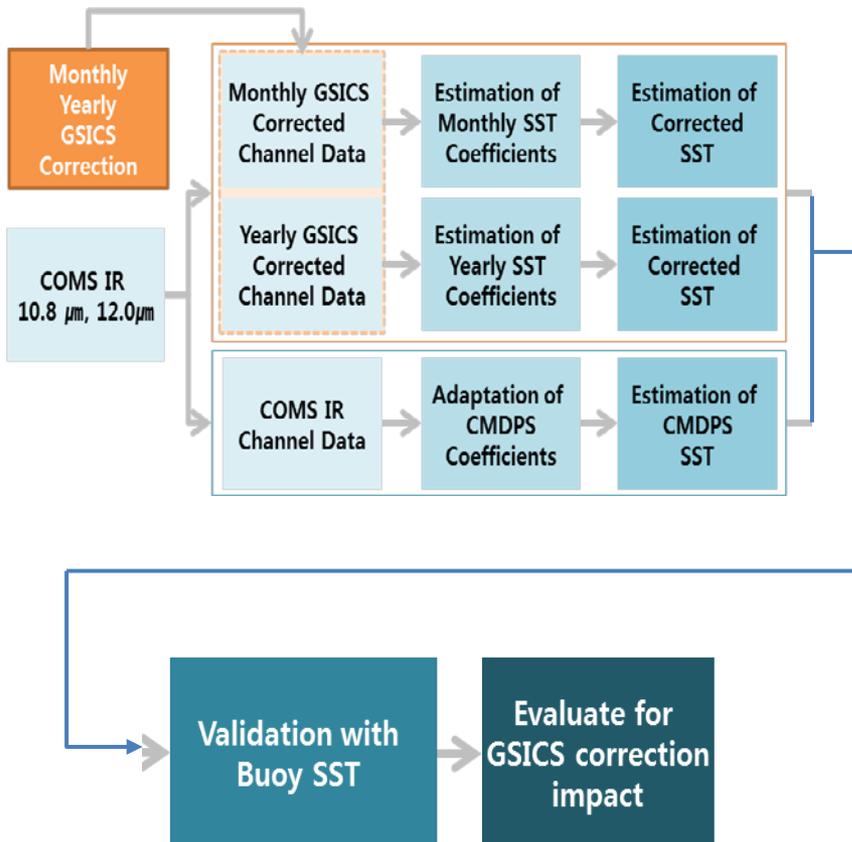# GSICS Procedure for Product Acceptance

Submission Phase			
ISRO (INSAT/IASI)	KMA (COMS/IASI)	EUM (DCC, Prime)	CMA (FY-2/IASI)

Demonstration Phase		
4 EUMETSAT	17 NOAA	6 JMA

Pre-operational Phase
4 NOAA products (GOES-11,12,13,15 / IASI,AIRS)

Operational Phase
4 EUMETSAT products (Meteosat 9-10/IASI)

IR Inter-calibration available through the whole GEO ring

Comparing GEO-LEO and GEO-GEO Differences

- To validate uncertainty estimates and ensure L1 data consistency
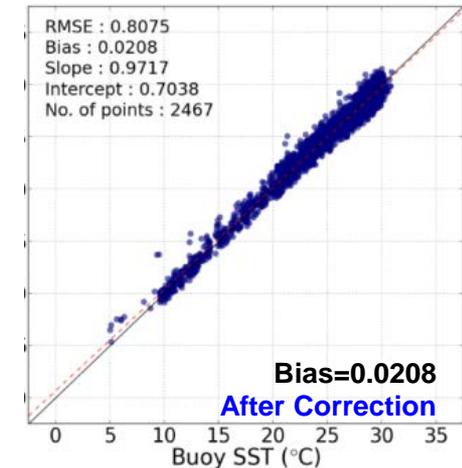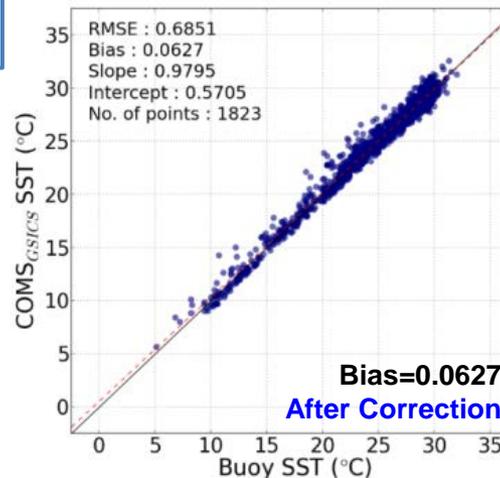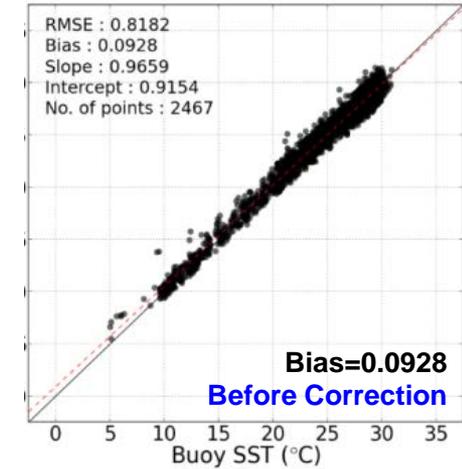- To generate globally consistent L2 products

Application of GSICS correction to SST (Sea Surface Temperature)

Daytime SST

Before Correction:
RMSE : 0.8928
Bias : 0.5377
Slope : 0.9446
Intercept : 1.911
No. of points : 1823

Bias=0.5377
Before Correction

After Correction:
RMSE : 0.6851
Bias : 0.0627
Slope : 0.9795
Intercept : 0.5705
No. of points : 1823

Bias=0.0627
After Correction

Nighttime SST

Before Correction:
RMSE : 0.8182
Bias : 0.0928
Slope : 0.9659
Intercept : 0.9154
No. of points : 2467

Bias=0.0928
Before Correction

After Correction:
RMSE : 0.8075
Bias : 0.0208
Slope : 0.9717
Intercept : 0.7038
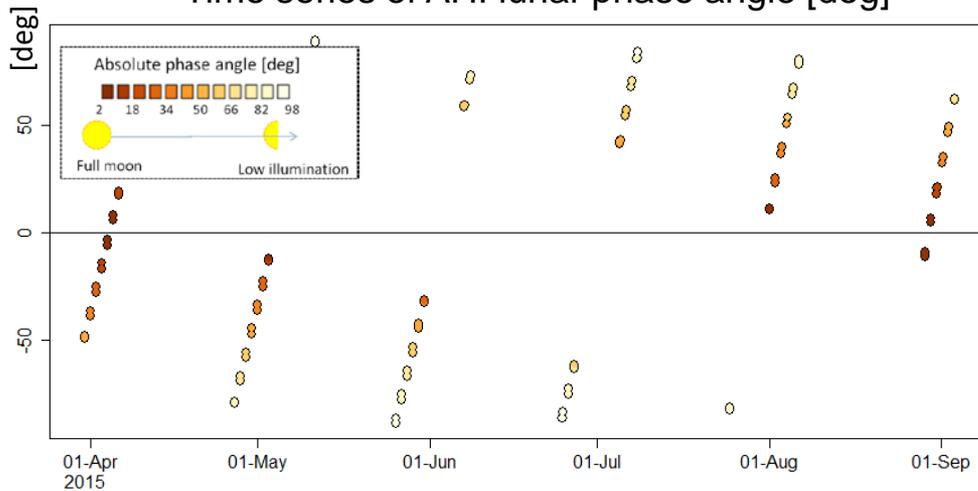No. of points : 2467
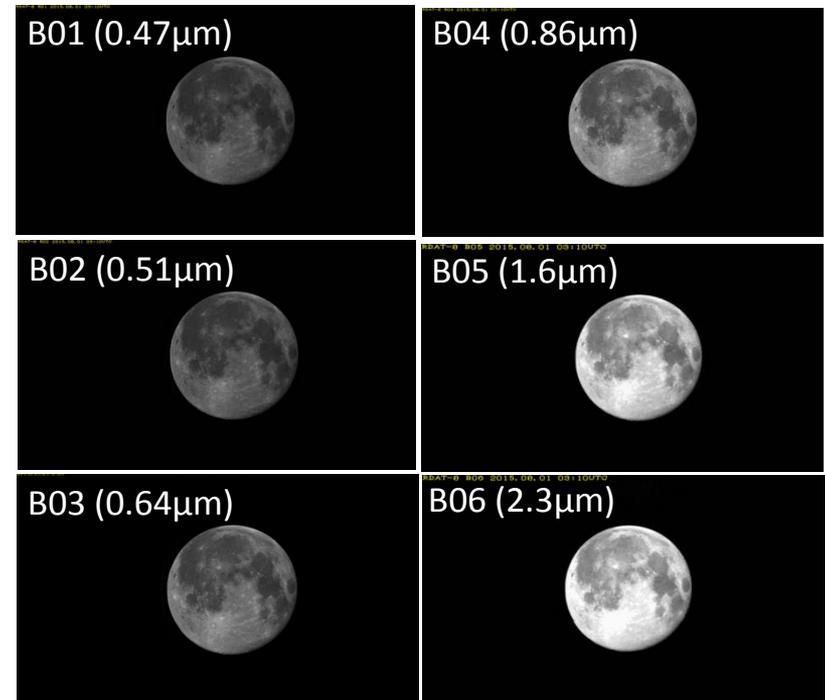
Bias=0.0208
After Correction

AHI Lunar Observation for GIRO
Slide from JMA

- **2979** useful lunar observations for the GIRO

  within the applicable phase angle:

  2 deg <= |phase angle| <= 92 deg

- 47 days data

  → 60-70 lunar observation / day on average

Time series of AHI lunar phase angle [deg]

2015-08-01T03:03:26Z (phase angle: 10.5deg)
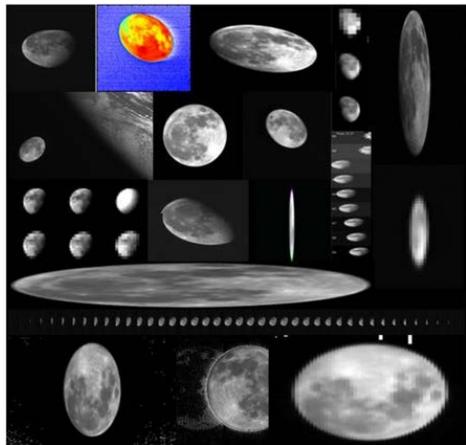

B01 (0.47μm) B04 (0.86μm)
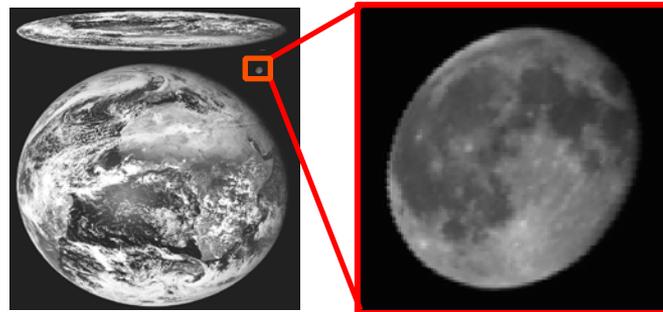B02 (0.51μm) B05 (1.6μm)
B03 (0.64μm) B06 (2.3μm)
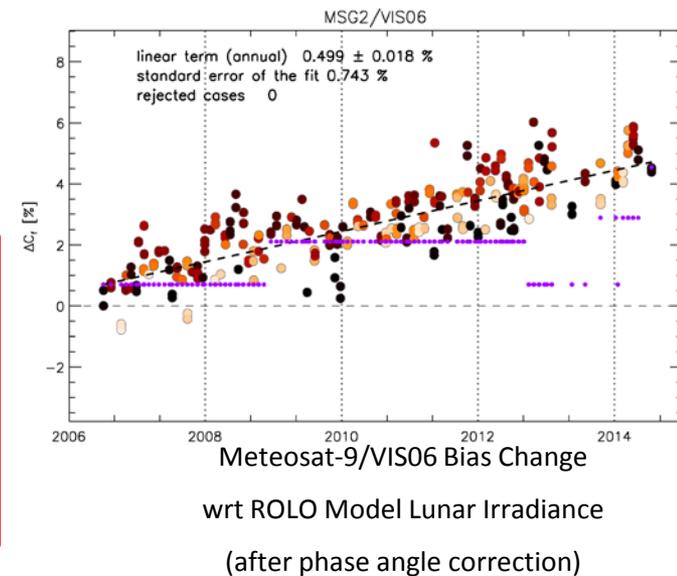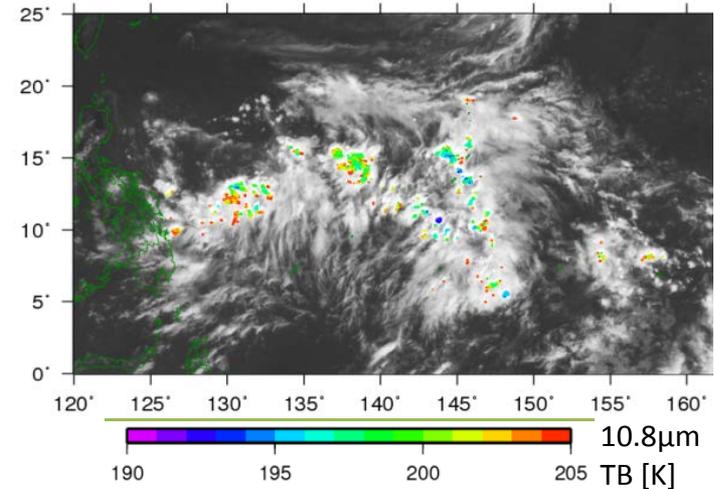
GEO-LEO VIS/NIR

- Currently two main activities on-going:
  - Inter-calibration of GEO imagers with MODIS using Deep Convective Clouds as transfer target
  - Lunar calibration : and using the Moon for inter-calibration.

MTSAT-2 DCC detection 2012-07-01T04

10.8μm
TB [K]

SEVIRI L1.0 image

MSG2/VIS06

linear term (annual) 0.499 ± 0.018 %
standard error of the fit 0.743 %
rejected cases   0

Meteosat-9/VIS06 Bias Change

wrt ROLO Model Lunar Irradiance

(after phase angle correction)

CGMS-44 GSICS Report
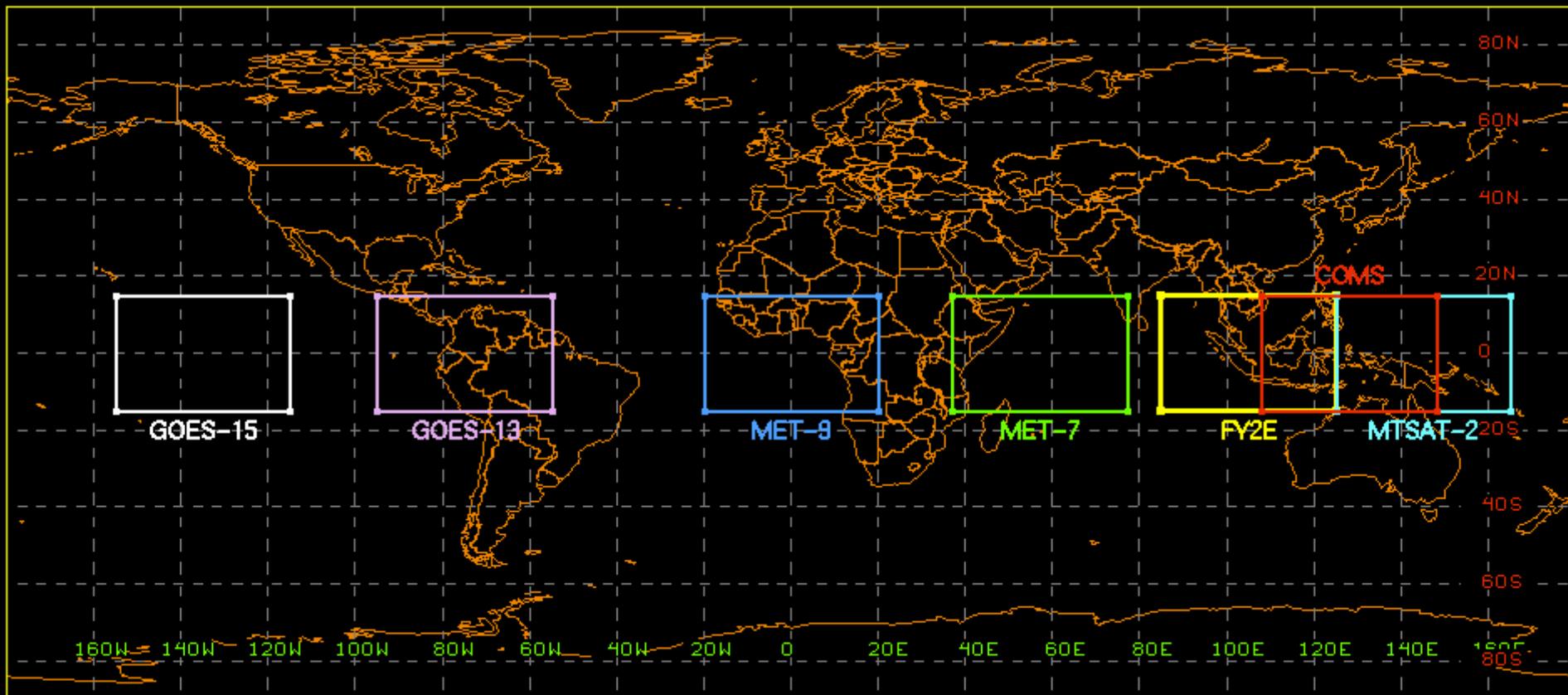
VIS-NIR intercalibration of GEO to LEO (MODIS) using DCC as transfer standard

- Soon in demonstration phase

Additional

- Agencies report in generally good progress
- Examples
  - CMA launch schedule – future CLARREO type mission (2022)
  - JMA products web site
  - Roshydromet IKFS-2 performancce
  - Roshydromet preparing new web-site

◆ **Actions and Recommendations** for an absolute lunar calibration reference
    (1) Satellite instrument operators should establish requirements to observe the Moon with VIS/NIR channel sensors.
    (2) Satellite operating agencies should support proposals and programs to acquire high-accuracy characterization measurements of the Moon, to develop a new, high accuracy, SI-traceable lunar reference standard for reflected solar wavelengths.
    (3) Long-term continuity of absolute solar spectral irradiance measurement with SI-traceable accuracy should be ensured.

◆ Conclusions
- The availability of a high-accuracy lunar reference standard: significant impact on Earth observation datasets acquired from space (by way of improved consistency and inter-operability across sensors and platforms)
  – provide benefits to climate monitoring programs & satellite operating agencies worldwide
- Requirements
  – collecting a new, high-accuracy set of characterization measurements of the Moon
  – redeveloping the lunar reference using this improved dataset

Meteosat-9 VIS0.6
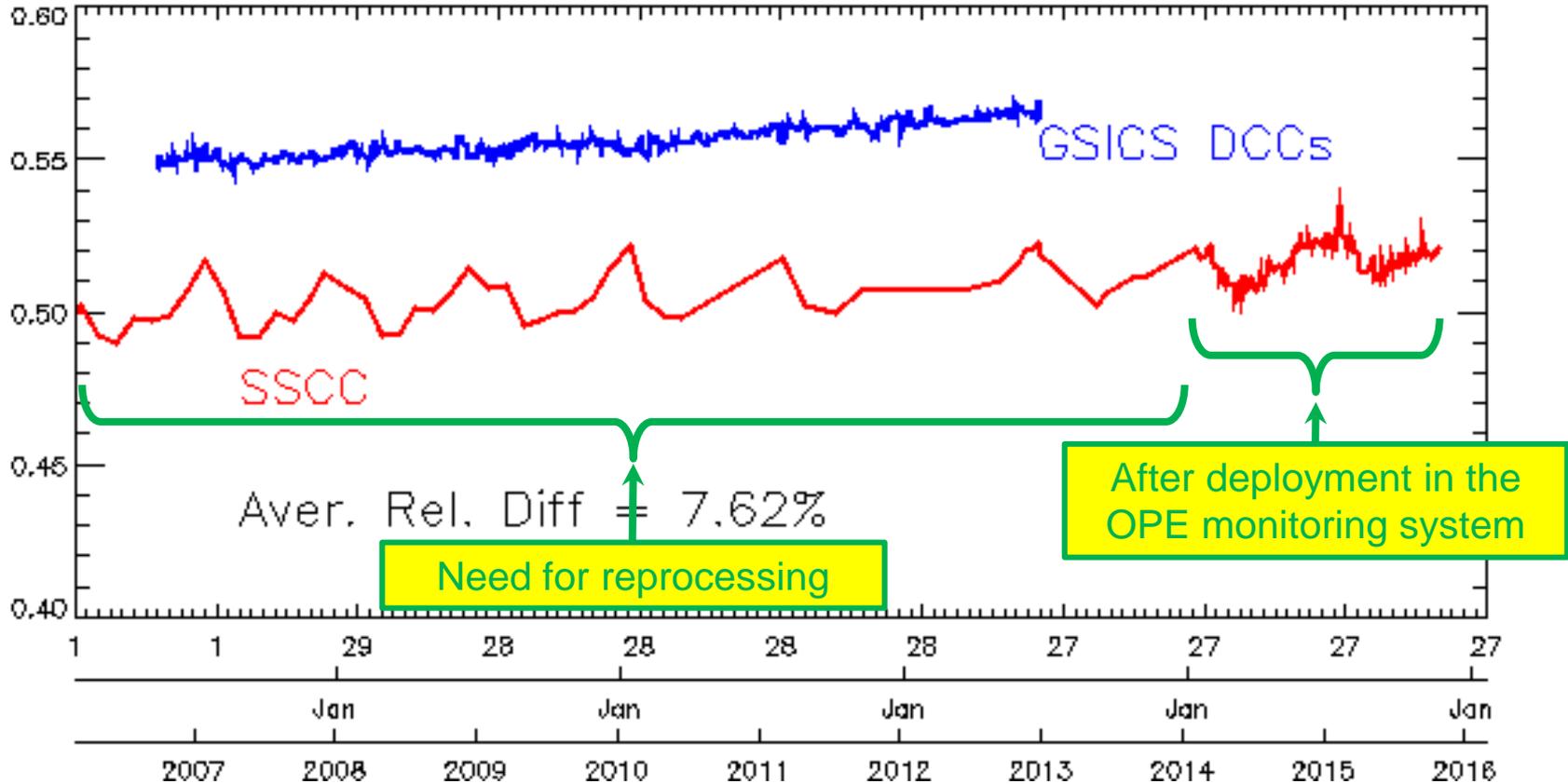
VIS0.6 Calibration Coefficient from inter-calibration w.r.t. Aqua MODIS using Deep Convective Clouds shows good agreement with user feedback

- Further development of GEO-LEO IR and DCC products
  - ✓ To progress existing products to Operational Status
  - ✓ To promote new products to Demonstration Status
- Development of lunar inter-calibration & merging with DCC
  - ✓ To finalize implementation and monitor the GSICS VIS/NIR product
  - ✓ To put in place an algorithm using the Moon as a transfer target
- GEO-ring demonstrator
  - ✓ to recalibrate IR and WV radiances for multiple GEO satellites
  - ✓ to support the generation of SCOPE-CM FCDRs
  - ✓ to analyse GEO-ring test dataset and SBAF tool
- Application of "Prime GSICS Correction" concept
  - ✓ to merge multiple reference instruments and multiple methods
  - ✓ to allow corrections to cover diurnal cycle

GRWG Issues presented to CGMS WG II

- Using the Moon as transfer standard for VIS/NIR calibration, combined with ground-based Moon observation and space-based solar observations
  - Requirements for lunar calibration (CGMS-44_GSICS-WP-02)
- Strategy for calibration reference standards
  - Use of merged references to ensure a robust, representative, stable and continuous calibration «Prime reference» concept (CGMS-44_GSICS-WP-02)

Other on-going developments

- Uncertainty evaluation

- Microwave intercalibration
  - Need references..

- UV activities
  - Evaluation of reference spectrometers

GDWG Highlights

- GSICS Website Review; identification of minimum requirement / updates

- Roll out of the GSICS Wiki on a New Server (gsicswiki.net)

- Process for bringing the GIRO Deliverables to their Users

- Realising Collaboration Software Development to preserve GSICS products

- Finalising the Instrument information landing page for the WMO OSCAR

- New Meta-data, conventions and template for existing and new GSICS Products; GEO-LEO-IR (existing), GEO-LEO-VNIR (new)

GDWG Work Plan 2016/2017

– Updating collaboration server products' structure.

– Updating current GSICS product plotting tool to support new GSICS products

– Exchange of GSICS products between collaboration servers (To Be Tested)

– New GSICS product templates

– GSICS products checker tool (maybe)

GDWG Membership Encouragement

- To encourage GPRCs to nominate their personnel to contribute towards the GDWG membership, the benefits of GDWG membership should be clarified. These are:
  - Be informed of GSICS guidelines, conventions and standards that can be by their own organisational work that are already familiar to the user community.
  - Contribute towards the development of conventions and standards, with a view to submitting them for inclusion to International conventions and standards organisation e.g. OGC (Open Geospatial Consortium), CF (Climate and Forecast metadata), etc.
  - Data Management development skills can be transferred between collaboration partners.
  - Encourage collaboration through exchange visits to build partnerships.

Data Management Highlights

- Progress made
  - Defined metadata conventions, templates for new data types
  - Tools (product generator, product checker, plotting, ..)
  - Configuration of collaborative servers : automation

- Issues
  - Ensure actual participation of members to GDWG activities:
    to be *informed* of, *contribute* to, and *benefit* from the collaboration
  - GSICS reaching the operational stage, requires operational support from GDWG (e.g. administration of THREDDS servers) in addition to the advisory and development role
  - Need to prepare successors to lead GDWG

GDWG Work Plan

- Review of Terms of Reference
  - Actual scope is wider than originally foreseen
- Updates collaboration server products' structure.
- Update current GSICS product plotting tool.
- Exchange of GSICS products between collaboration servers (To Be Tested)
- New GSICS product templates
- GSICS products checker tool (maybe)
- Manual action tracking process

Outline

1. GSICS purpose and organization

2. Highlights of recent activities

3. **Recommendations**

Recommendations/challenges

- **Engagement of GSICS members**
  - There is broad participation of GSICS members in GRWG, but more engagement of is expected for faster progress and early benefits
  - More active participation is necessary in GDWG to be informed of, contribute to, and benefit from the standardization effort and development of tools.

- **User requirements**
  - Encourage external and internal users to clarify their requirements to help GSICS to focus on the high impact issues

ISCCP and SCOPE-CM

- Project to be formulated where ISCCP is using GSICS methodologies and data for generating an new ISCCP data set

- SCOPE-CM IOGEO endorsed
  - Schedule(need re-planning)
  - Data set analysis
  - SBAF

GSICS Input to WIGOS Vision for 2040

Component 1: Backbone system with specified orbital configuration and measurement approaches	
Instruments	Geophysical variables and phenomena
High-accuracy solar/lunar VIS/NIR imaging spectrometer and Solar spectral irradiance sensor, as on-orbit VIS/NIR reference standard	VIS/NIR absolute calibration using the Moon's reflectance as transfer standard.
High-accuracy phase-change cell black-body IR spectrometer as on-orbit IR reference standard	TIR absolute calibration

Component 2. Backbone system – Open measurement approaches	
Instruments	Geophysical variables and phenomena
On-orbit passive MW measurement reference standards	Passive MW absolute calibration of atmospheric channels
On-orbit UV measurement reference standards	UV absolute calibration

Summary

- First GSICS products are declared operational !

- Very good user feedback in particular from satellite operators

- Members to strengthen their engagement in GSICS and in particular in GDWG

- All CGMS Members invited to join GSICS

- Members to analyze their requirements for calibration

- Support inclusion of calibration references in the Vision 2040

- Support GSICS engagement with CEOS/WGCV in the Architecture for Climate Monitoring from Space

- Support GSICS efforts for outreach: to further document GSICS and communicate to ensure visibility and full benefit