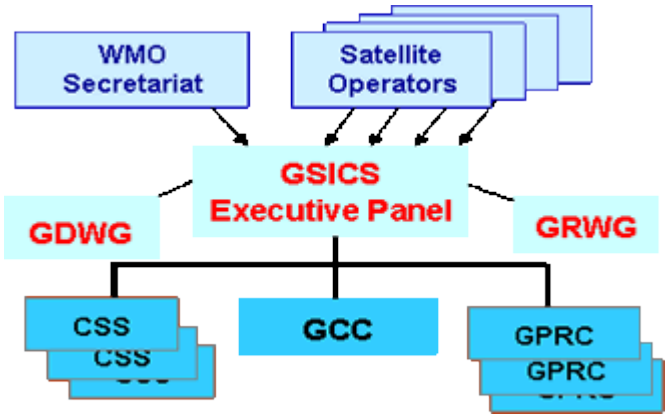
GSICS Research Working Group (GRWG)

Dohyeong Kim, Chair

Tim Hewison, Vice Chair

GSICS Users' Workshop, College Park, 11 August 2016

GRWG Structure



http://gsics.wmo.int/gsics-structure.html

NOAA GPRC

User Support
- Operation
- Data
- Web
- …

Research
- UV
- VIS
  - Lunar
  - DCC
  - …
- IR
- MW

GSICS Research Working Group
Chair: Dohyeong Kim
Vice-Chair: Tim Hewison
Vice-Chair: Scott Hu

UV Sub-Group
Chair: Rose Munro

VIS/NIR Sub-Group
Chair: Dave Doelling

IR Sub-Group
Chair: Tim Hewison

Microwave Sub-Group
Chair: Ralph Ferraro

Annual Meeting

- Every March since 2007
- Monday: Mini Conference
- Tuesday: Agency and WG Briefing
- Wednesday: GRWG & GDWG split
- Thursday: GRWG & GDWG split
- Friday: Summary and Actions

Mini Conference Agenda

	Chair: Larry Flynn				
9:00	Tim Hewison	EUMETSAT	Introduction to Mini Conference & GSICS	1a	0:20
9:20	Chu Ishida	JAXA	Welcome to JAXA	1b	0:10
9:30	Yoshiteru Kitamura	JMA	Welcome address	1c	0:10
9:40	Dave Doelling	NASA	CLARREO Pathfinder	1d	0:20
10:00	Rob Roebeling	EUMETSAT	FIDUCEO - Defining FCDR uncertainties	1e	0:20
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11:50			**Lunch Break**		1:10
	Chair: Misako Kachi				
13:00	Fougnie Bertrand	CNES	Toward a wider use of the moon for in-flight characterization	1i	0:20
13:20	Seongick Cho	KIOST	Operation and Calibration of GOCI	1j	0:20
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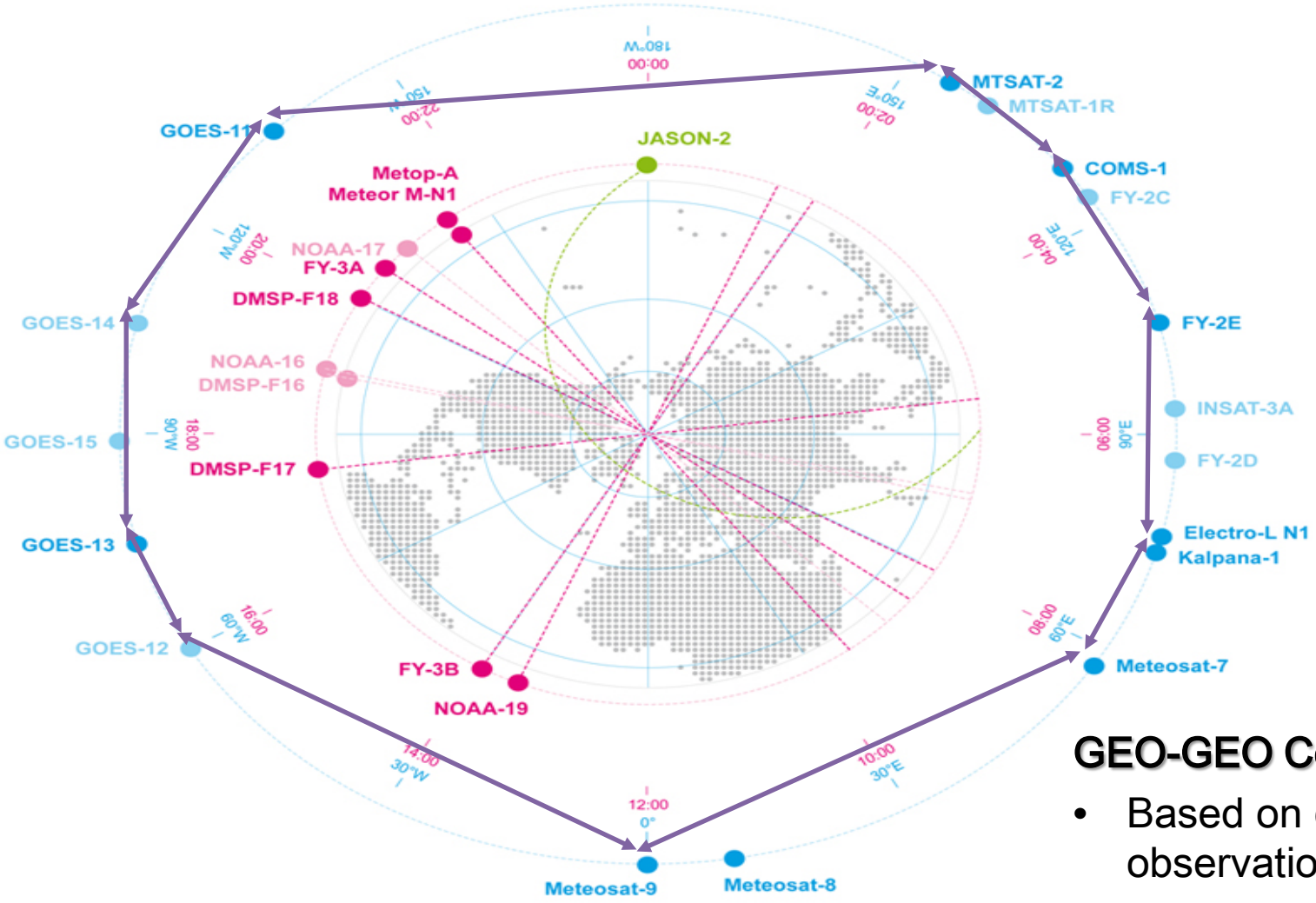
18:10	All		Discussion		0:20
18:30			**END**		

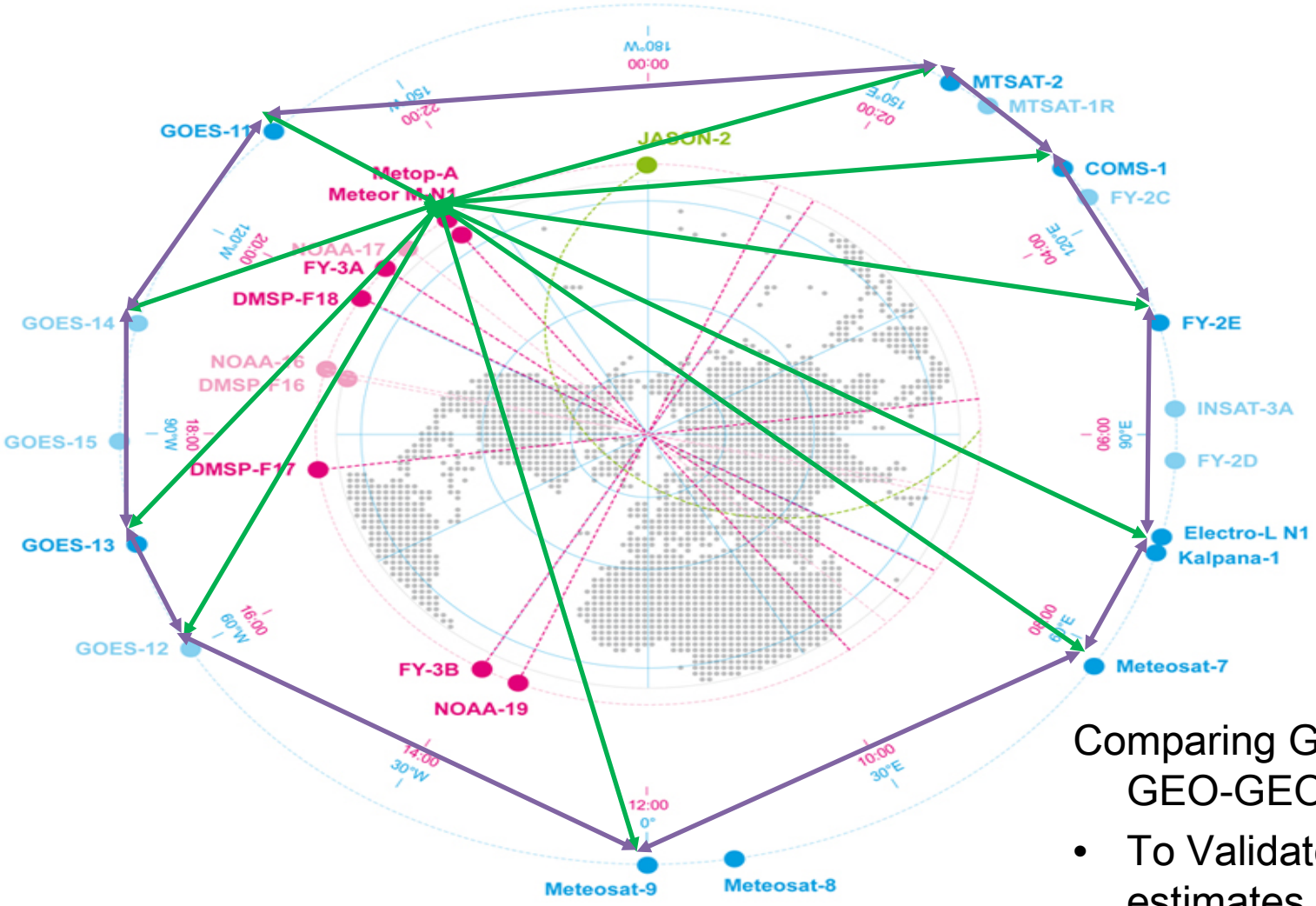
Date	Group	Topics
2017-03-TBD	**GRWG/GDWG**	**Annual GRWG+GDWG Meeting - Location TBC**
2017-01	GRWG VIS/NIR - S.Wagner	Lunar Inter-Calibration Double-difference between MODIS/VIIRS and GIRO - Seb to re-scope
2016-12	GRWG MW Subgroup	Microwave Sub-Group web meeting
2016-12	GRWG VIS/NIR	Joint web meeting with IVOS, ACSG on use of SBAF tool
2016-12	GRWG IR Subgrou	IR Reference Traceability Report - Review progress - including draft error budgets
2016-11	GDWG - M.Takahashi	NetCDF generation framework
2016-10	GDWG - P.Miu	GSICS Working Groups' Actions Tracking Tool Requirements and Discussion
2016-10	GRWG VIS/NIR	Publications on DCC algorithm and results
2016-??	GRWG - T.Hewison	Scoping inter-calibration opportunities using NWP bias monitoring statistics - including Ignatov, ECMWF, UKMO, RR, Reale
2016-??	GRWG+GDWG - GCC	GRWG/GDWG web meeting on User Requirements (maybe not needed?)
2016-??	GRWG UV Subgroup	Ultraviolet Sub-Group web meeting
2016-??	GRWG VIS/NIR - D.Doelling	Web Meeting with IVOS and ACC/ACSG: reference solar spectrum to convert from radiance to reflectance + SBAF tool?
2016-??	GRWG+GDWG - GCC	GRWG/GDWG web meeting on instrument performance monitoring
2016-09-08	GRWG IR Subgroup	IR Reference Traceability Report - Define channel binning and spectral conversion methods
2016-08-30	GRWG VNIR Subgroup	Lunar Calibration
2016-08-11	**Users**	**2016 GSICS Users Workshop**
2016-07-26	GRWG MW Subgroup	Microwave Sub-Group web meeting
2016-07-05/06	**GRWG MW - Cheng-Zhi Zou**	**CEOS-GSICS Microwave Coordination Meeting**
2016-06-21	GRWG IR Subgroup	IR Reference Traceability Report - Agree structure, authors and templates
2016-04-21	GRWG MW Subgroup	Microwave Sub-Group web meeting
2016-02-29/03-04	**GRWG/GDWG**	**Annual GRWG+GDWG Meeting at Tsukuba, Japan**
2016-02-04	GRWG - VIS/NIR - D.Doelling	DCCs, Combining VIS methods, Agenda for Annual Meeting
2016-01-06	GRWG - MW Subgroup	Update on MW calibrations and standards, preparation for GRWG+GDWG Annual Meeting
2015-12-03	GRWG+GDWG - R.Roebeling	Instrument Information Landing Pages for OSCAR
2015-11-03	GRWG VIS/NIR	DCC - Plotting Tool Requirements, GPPA Review, Latest Ray-matching results
2015-10-08/09	**GRWG UVSG**	**Joint Meeting of GRWG UV and WGCV Atmospheric Composition Sub-Groups**



GEO-GEO Comparisons

- Based on collocated observations
- GEO imager pairs
- Need Spectral Band Adjustment Factors (SBAFs)

Hewison, 2016 GSICS Annual Meeting



Comparing GEO-LEO and GEO-GEO Differences

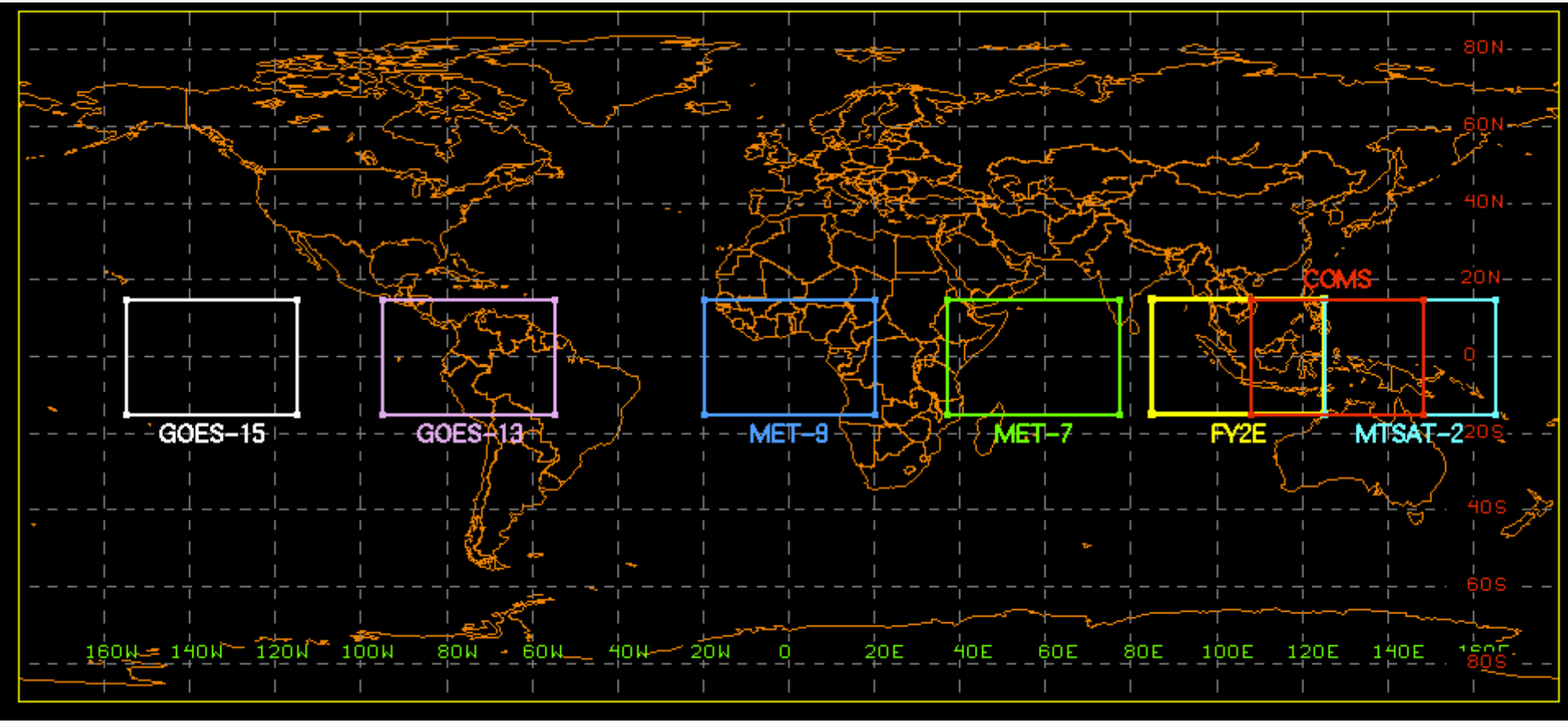
- To Validate Uncertainty estimates
- Ensure consistency

Generate global L2 products

Hewison, 2016 GSICS Annual Meeting

GEO DCC Domain

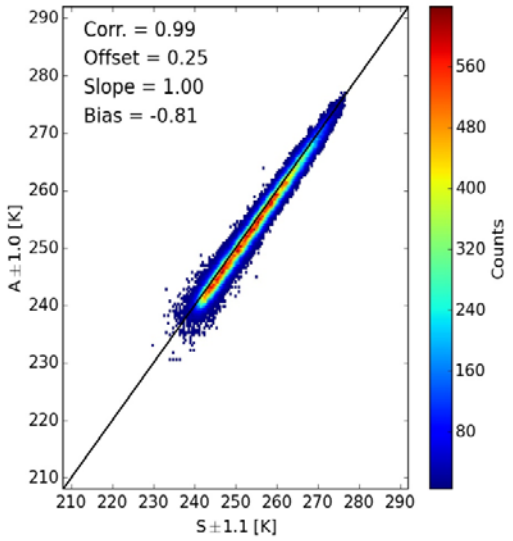
±15° latitude and ±20°E-W longitude from a GEO's sub-satellite point.

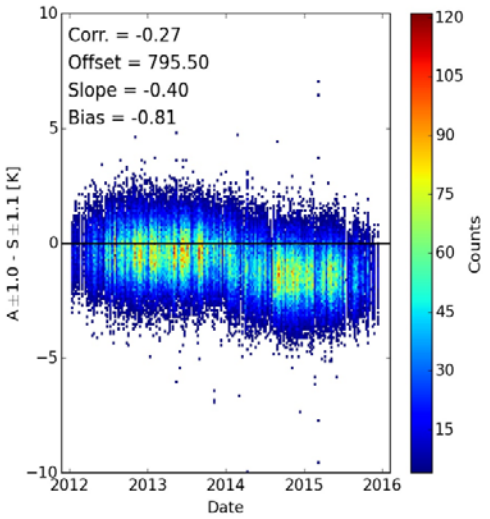


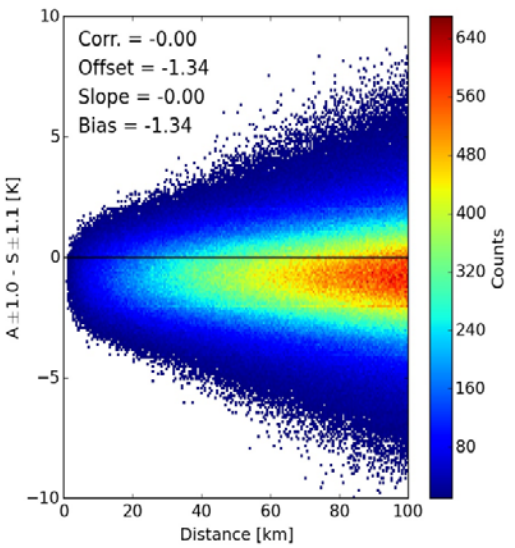
	GOES-15	GOES-13	MET-9	MET-7	FY2E	COMS	MTSAT-2
Orbit	135°W	75°W	0W	57°E	105°E	128°E	145°E

Doeling, 2016 GSICS Annual Meeting

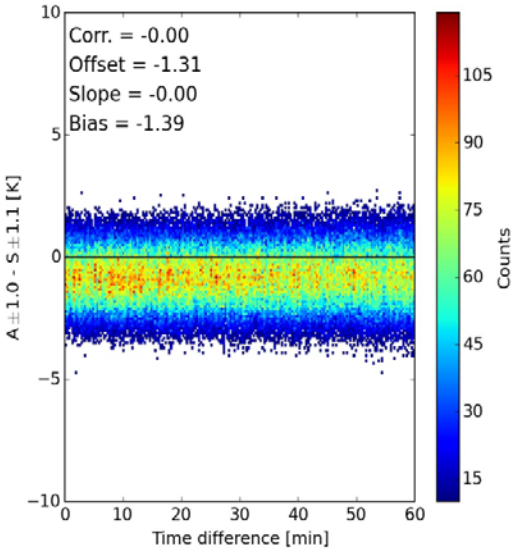
SAPHIR-ATMS Comparison

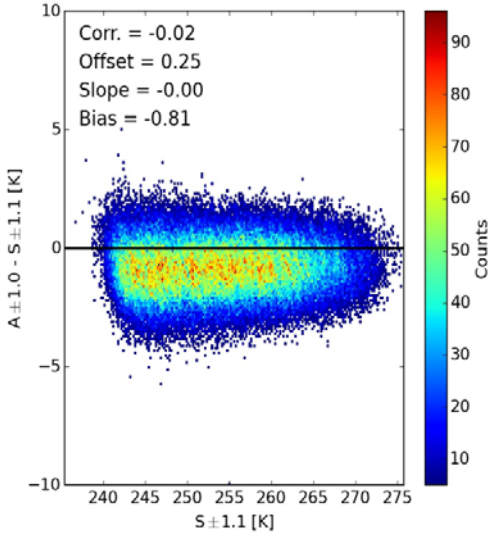






Plots for all 4 similar channel pairs are available

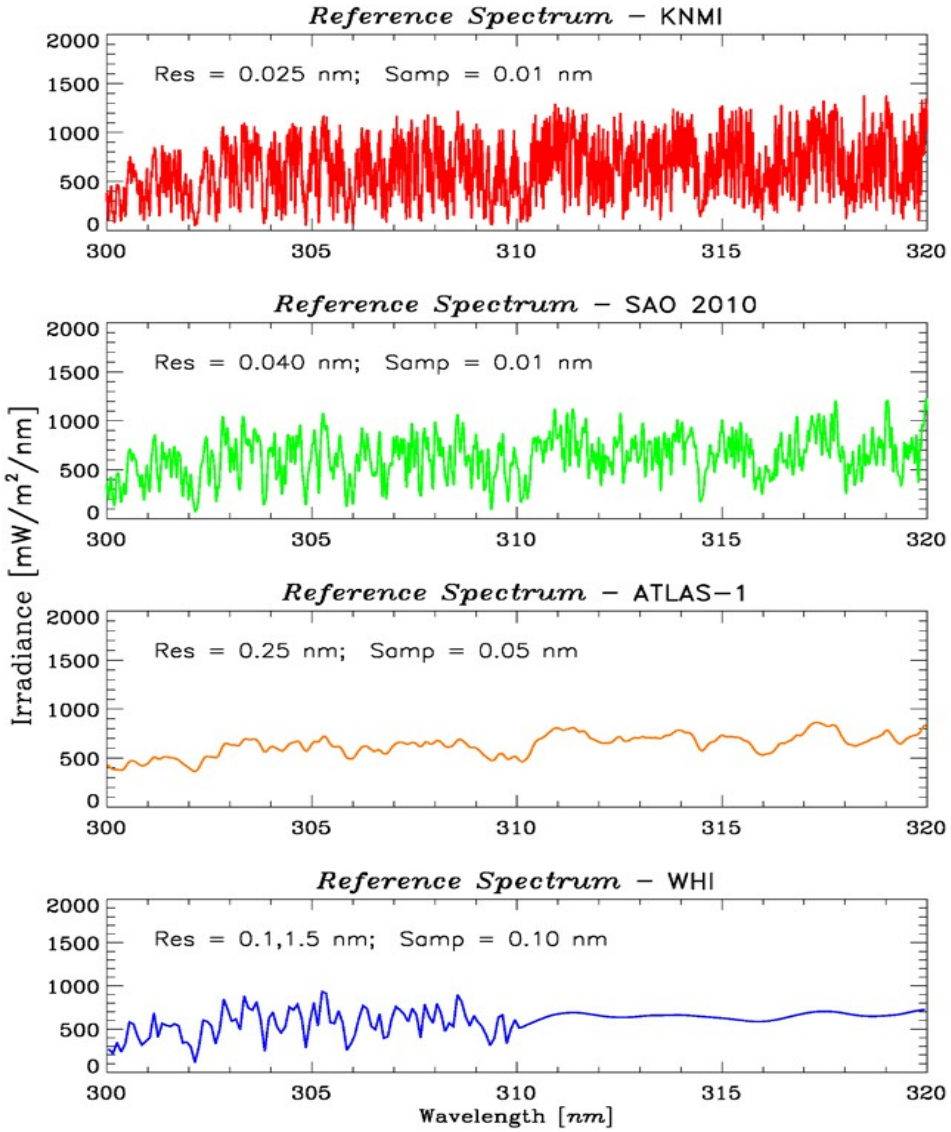




Ferraro, 2016 GSICS Annual Meeting

Solar UV Spectra Project

- Same spectral region (300-320 nm) and absolute scale used for all panels in this figure.
- Effect of bandpass change between KNMI and SAO is apparent, even with same input data set.
- Satellite measurements (bottom two panels) have lower resolution.
- WHI spectrum shows change in original instrument resolution when SIM data begin at 310 nm.



Interaction with CEOS

Joint GRWG-UVSG and CEOS WGCV-ACSG Meeting

- Joint Meeting for GSICS Research Working Group UV Sub-Group (GRWG-UVSG) and C EOS Working Group on Calibration and Validation – Atmospheric Composition Sub-Group (CEOS WGCV-ACSG)
  - ✓ NOAA/NCWCP, College Park, MD
  - ✓ 8-9 October 2015
  - ✓ User survey to assess the most appropriate focus for GRWG-UVSG

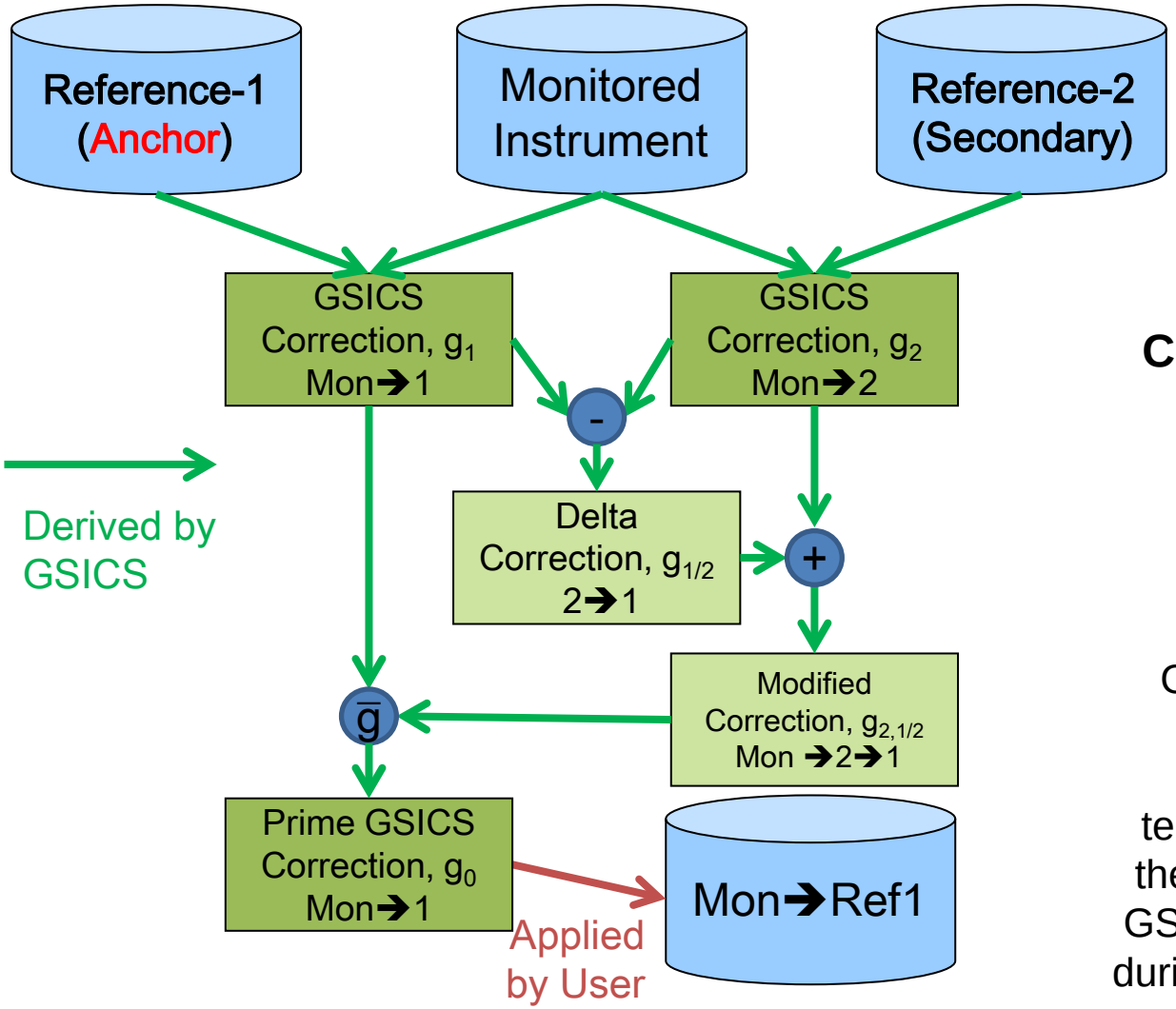
Joint GRWG-MWSG and CEOS WGCVMWSG Meeting

- Joint Meeting for GSICS Research Working Group Microwave Sub-Group (GRWG-MWSG) and CEOS Working Group on Calibration and Validation – Microwave Sub-Group (CEOS WGCV-MWSG)
  - ✓ National Space Science Center, Chinese Academy of Sciences, Beijing, China
  - ✓ 6-7 July 2016
  - ✓ Cal/Val of S-NPP ATMS and FY-3 MWTS/MWRI/MHTS.
  - ✓ Inter-calibration involving ATMS, SAPHIR, AMSU-B, SSM/T-2, COSMIC RO.

Joint GRWG and CEOS WGCV for the climate monitoring

- [Action] The GRWG Chair to invite the CEOS WGCV to work on a joint statement on procedures, best practices and calibration resources required to ensure consistency of data records through accurate and homogeneous calibration, as an input to the Architecture for Climate Monitoring from Space

Prime Correction



Correcting the Corrections and Blending References

Action: GRWG.2016.3e.1: Tim Hewison to consider revising terminology used in the current "Primary GSICS Corrections", during demonstration phase (closed)

Summary

- Overview of GSICS Research Working Group (GRWG) activities.
- Examples of GRWG sub-group activities.
- More details in the sessions for MW, IR, VIS, and UV.

BACKUP

GSICS Research Working Group (GRWG)

Overview

- **Introduction**
- GSICS Research Working Group
- Sub-Group
  - IR, VIS/NIR, MW, UV
- Issues for GSICS Users

2016 GRWG/GDWG Annual Meeting

- Monday: Mini Conference
- Tuesday: Sub-Group Briefing Report + Agency Reports(Plenary)
- Wednesday: GRWG : Plenary + IR Sub-Group, GDWG
- Thursday: GRWG : VIS/NIR Sub-Group (Lunar + DCC) + UV Sub-Group, GDWG
- Friday: Wrap-up(Plenary)

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Future GRWG/GDWG Meeting

- Full schedule of monthly web meetings
  - Published on GSICS Development Wiki
- 2017 GRWG/GDWG Annual Meeting
  - Possible host in North America

Overview

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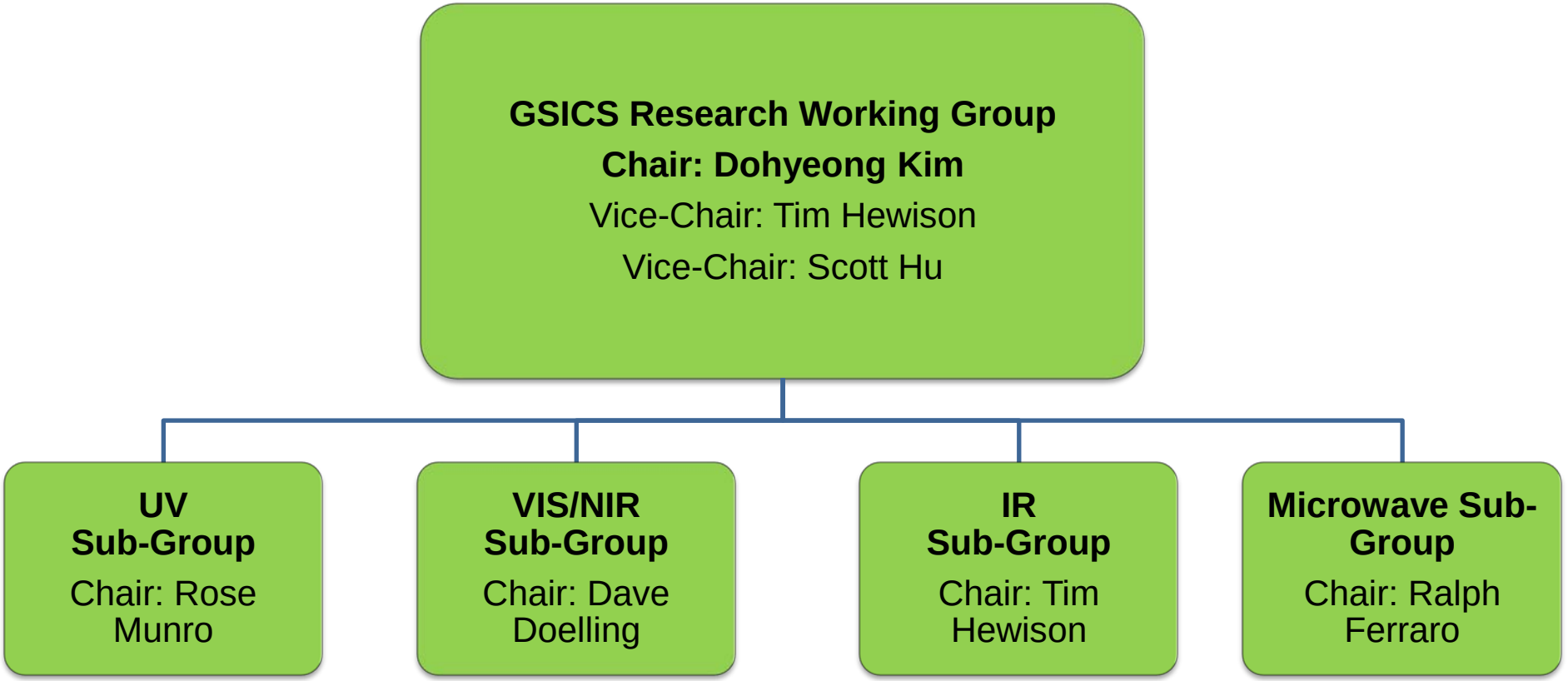
- **GSICS Research Working Group**
- Sub-Group
  - IR, VIS/NIR, MW, UV
- Issues for GSICS Users

GRWG Chairing



Overview

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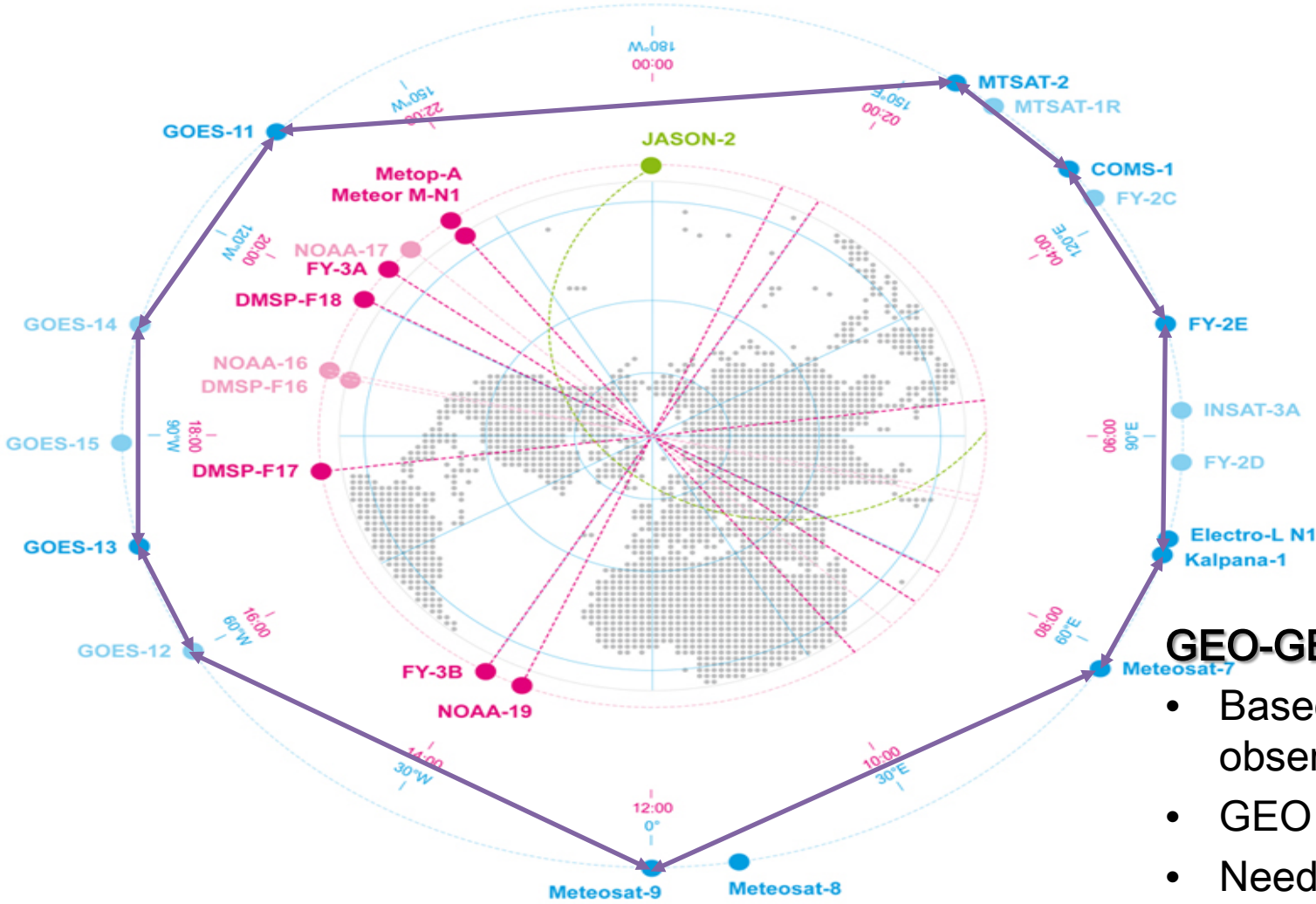
  - **IR, VIS/NIR, MW, UV**
- Issues for GSICS Users

IR Product Development within GSICS (IR)

- GEO-LEO IR hyperspectral
  - Progress existing products to Operational Status
  - Promote new products to Demonstration Status
  - Application of Prime GSICS Correction concept
  - To merge multiple reference instruments
    - To allow corrections to cover diurnal cycle
    - Other Agencies' plans for Prime GSICS Corrections?
- Scope potential new GSICS products/deliverables
  - Alternative inter-calibration algorithms
  - Retrieved SRFs
  - GEO-GEO inter-calibration (part of GEO-ring)
  - LEO-LEO inter-calibration
- Traceability of Reference Instruments
  - Plans for TANSO-FTS/2 & CLARREO
  - GSICS IR Reference Sensor Traceability and Uncertainty Report



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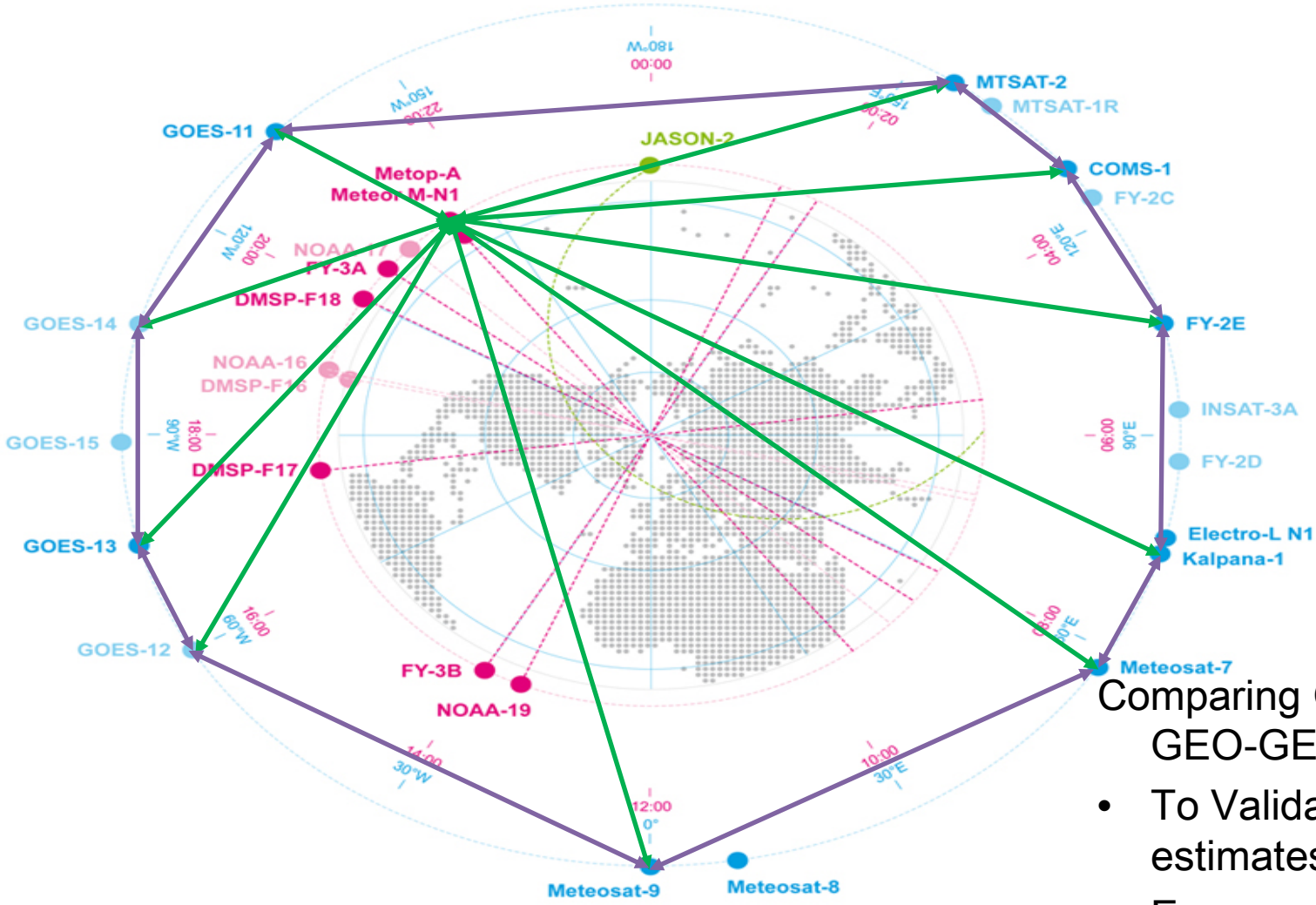


Comparing GEO-LEO and GEO-GEO Differences

- To Validate Uncertainty estimates
- Ensure consistency

Generate global L2 products

- Ensure consistency

DCC calibration Status (VIS/NIR)

- Started in 2014
  - NASA Langley provided all GPRCs verification data to validate the proper implementation according to ATBD submitted in 2011
- The DCC method has been implemented by all GPRCs by 2015 and reported on their status and issues of the implementation
- The DCC methodology provides excellent estimate of the relative degradation of the monitored instrument, however the GEO domain specific DCC methodology noise can be reduced by adjusting DCC methodology components as needed

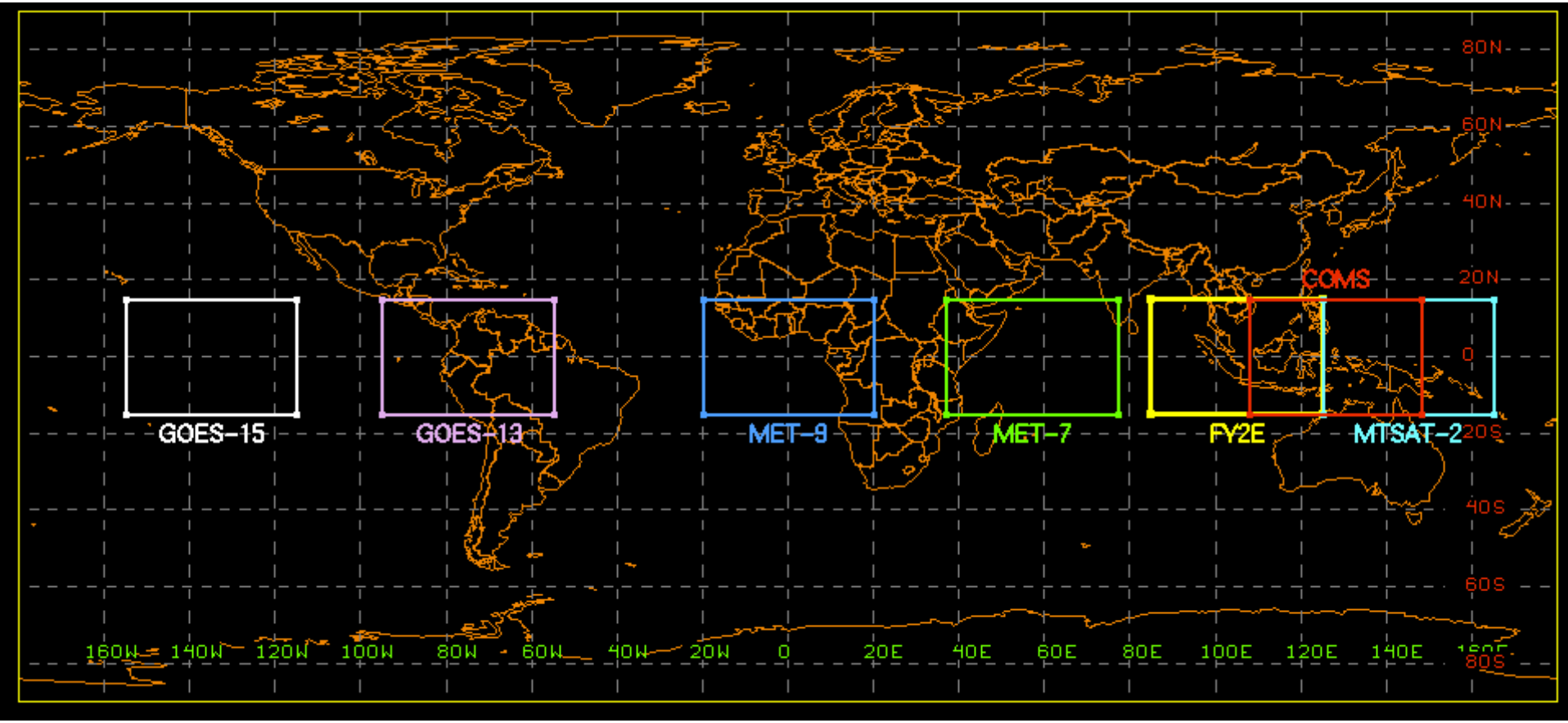
1) DCC BRDF
   - ✓ KMA has evaluated BJ Sohn model
   - ✓ CNES has defined the more Lambertian part of the BRDF
2) DCC deseasonalization
   - ✓ NOAA, EUMETSAT, CMA have developed methods
3) DCC statistic (mean, mode, median) and identification (to provide sufficient sampling)

Outstanding issues on DCC (VIS/NIR)

- Consistent GSICS DCC calibration and DCC ray-matching calibration results (<0.3%)
- To work on the uncertainty of the calibration transfer.
  Comparison of Gridded, DCC (10km), DCC (30km) and DCC (Reg)
  - MET-9: <0.25%, MTSAT-2 : <0.29%, GOES-15 : <0.21%
- GEO-LEO-VISNIR product(s) will enter Demonstration-Phase in 2016
  - SEVIRI vs. Aqua/MODIS product: in GPPA
  - At present, NASA DCC method is only available, but products (netCDF) will contain multiple calibration methods' results in one file in future
  - NetCDF convention: almost fixed, but need to discuss the use of enhanced data model (grouping function on netCDF-4) within GRWG/GDWG
  - Requirement documents for GSICS Plotting Tool should be prepared by GRWG
- Action: Dave to coordinate the writing of a paper on the GSICS DCC GEO-LEO algorithm.

GEO DCC domain (VIS/NIR)

A fixed DCC domain confined to ±15° latitude and ±20°E-W longitude, and centered at the GEO sub-satellite point is defined for each GEOSat.



	GOES-15	GOES-13	MET-9	MET-7	FY2E	COMS	MTSAT-2
Orbit	135°W	75°W	0W	57°E	105°E	128°E	145°E

Scope of Microwave Sub Group (MW)

- **Understanding the users' requirements** for inter-calibration products for microwave instruments
  - Imagers + sounders – passive only (initially, but eventually consider active if there is a need…)
  - Retrospective calibration (CDR's and their components like geolocation, scan biases, inter-satellite)
  - Forward looking calibration (near-real time uses)
- **Identifying existing products** that could meet those requirements, but first….
  - Need to define criteria…Reference standards (sensor(s), models, calibration methodologies….)
  - And then a process that adheres to GSICS principles
- **Focusing on tools/algorithms** like SNO, Double Difference, RTM, etc.
  - Might be something more feasible in near term?
- Define data standards (jointly with GDWG)
- Encourage the creators of those products to submit them to the GSICS Procedure for Product Acceptance (GPPA), once its defined for MW
  - Candidates include Cheng-Zhi Zou (MSU-AMSU), Karsten Fennig (SSMI), GPM X-Cal LUT's
- GSICS Products could be developed within the Microwave Sub-Group
- **Coordination with other groups** (e.g., CEOS WGCV MW, GPM X-Cal) would also be required to generate standards and best practices

Focus Topics for 2016 (MW)

- Defining CLEAR PATH for **GSICS MW products and algorithms**
  - Methodologies *(TBD)*
    - SNO, Double difference, etc.
  - Reference Standards *(TBD)*
    - A particular sensor? Likely to be wavelength dependent (e.g., window, O_2, H_20); A RTM?
  - LUT/Correction Tables *(TBD)*
    - Near real-time and climate; they will be different
- **Tying together other groups/opportunities**
  - Engaging more closely GPM X-Cal *(Wes, Rachel)*
  - Formalizing linkages to CEOS MW subgroup *(Cheng-Zhi, Xiaolong Dong)*
    - *CEOS-GSICS Microwave Coordination Meeting – 2016 July 5-6, Beijing, China (at time of IGARSS 2016)*
      - *Can there be a common definition of standards?*
      - *Define some concrete collaborations*
  - Expanding active participation – India, others? *(Manik, Ralph)*
- Participation by subgroup at upcoming meetings of relevance:
  - GSICS; CEOS;CALCON, Microrad 2016, AMS Sat. Met, EUMESAT Satellite, etc.

GSICS UV Solar Spectra Project (UVS)

- The purpose of this project is to compare solar measurements from BUV (Backscatter Ultraviolet) instruments.
- The first step is **to catalog high spectral resolution solar reference spectra and agree on a common one to use for the project**
- For each instrument, participants should provide the following datasets:
  - Solar measurement for some date (wavelength scale, irradiance) adjusted to 1 AU
  - Wavelength scale and bandpass (Δλ, # of points, bandpass centers, normalized bandpass weights)
  - Synthetic spectrum from common reference (wavelength scale, irradiance)
  - Synthetic for wavelength scale perturbations (±0.01 nm) from common reference (wavelength scale, irradiance)
  - Synthetic from alternative reference spectra (wavelength scale, irradiance)
  - Solar activity pattern (wavelength, relative change)
  - Mg II index (if 280 nm is covered) Mg II 279.6 Mg I 285.2 (date, index)
  - Ca H/K index (if 391 nm to 399 nm is covered) CA II 393.4 and 396.8.
- Goals:
  - **Agreement at 1% on solar spectra** relative to bandpass-convolved high resolution spectra as a transfer after identifying wavelength shifts and accounting for solar activity
  - **Long-term solar spectral measurement drift and instrument degradation** by using OMI solar activity pattern (with internal confirmation from Mg II Indices and scale factors)

Project to Compare Solar Measurements (UV)

- **High resolution solar reference spectra**
  - Reference high resolution solar Spectra (SOLSTICE, SIM, Kitt Peak, etc.
    - Everybody has a favorite. How do they compare?)
  - Mg II Index time series, Scale factors at high resolution
- **Instrument data bases**
  - Bandpasses, wavelength scales (Shift & Squeeze codes)
  - Day 1 solar, time series with error bars (new OMI product) (Formats, Doppler shifts, 1 AU adjustments)
  - Mg II Indices and scale factors at instrument resolution
  - Reference calibration and validation papers
- Using the information from above we can compare spectra from different instruments and times

Overview

- Introduction
- GSICS Research Working Group
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- **Issues for GSICS Users**

Improving the lunar reference

- **Improvement of the reference standard for lunar calibration**
  - to improve absolute accuracy
  - to reduce residual geometry dependencies (phase, librations)

- The reference irradiance is generated for each observation of the Moon taken by an instrument by computing the lunar model(ROLO, GIRO)

- **Requirements for an Absolute Lunar Calibration Reference**
  - reprocessing the ROLO telescope dataset using new algorithms
  - incorporating reliable new observational data e.g. PLEIADES
  - lunar radiometry e.g. SNPP VIIRS
  - collecting new radiometric measurements of the Moon
  - requirements:
    - high-accuracy, with traceability to SI
    - full spectral coverage at moderate spectral resolution
    - photometric geometry coverage (phase and librations) sufficient for high-precision modeling

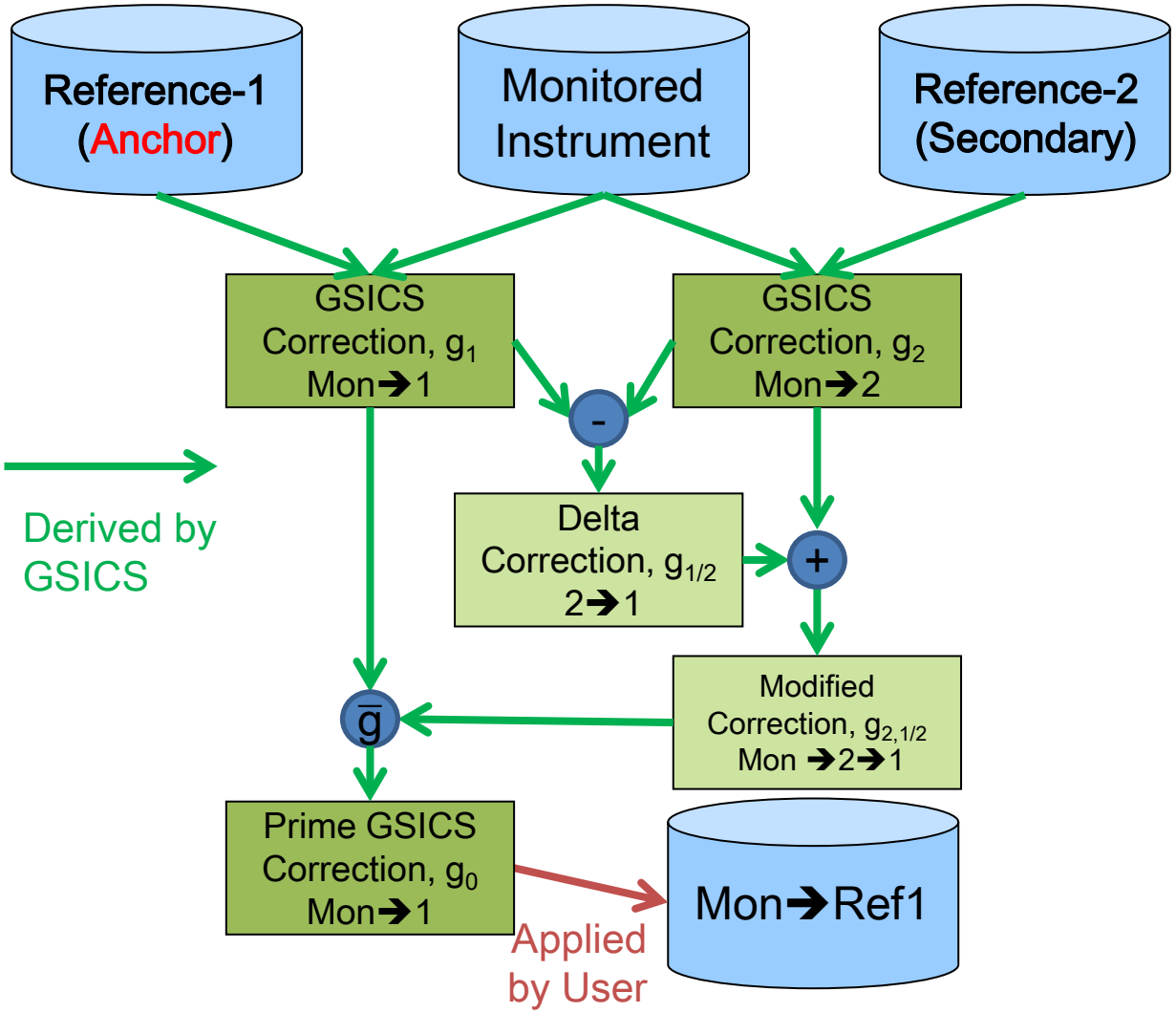
Plans for Prime Correction

- **Proposed reference instruments selection scheme**
  - Metop/IASI meets the essential requirements for all instruments in this class
  - Aqua/AIRS and SNPP/CrIS do not meet the essential requirements of all the instruments in this class (as they do not provide spectral coverage of the IR8.7 channel of Meteosat/SEVIRI)

- **Prime GSICS Corrections**
  - Application to inter-calibrate a monitored instrument (lifetime covers multiple reference instruments)
  - to consider the choice of an anchor reference: based on the uncertainty on the overall time series
  - Delta Correction: to derive from the double difference between pairs of GSICS Corrections for overlap (from Delta Correction, different reference instruments directly traceable to the anchor reference)
  - the uncertainties on coefficients of the GSICS Corrections are used to derive weights which are applied to the individual GSICS corrections to merge
  - to support the generation of FCDR and ensure robust inter-calibration product for near-real-time operational use
  - EUM will not develop further or progress beyond demo without user

Plans for Prime Correction

Correcting the Corrections and Blending References



- Action: GRWG.2016.3e.1: Tim Hewison to consider revising terminology used in the current “Primary GSICS Corrections”, during demonstration phase (closed)

User Requirements

- GSICS should contribute to architecture for Climate Monitoring from Space
  - Need to find a clear plan to communicate with users, collect and document the user requirements
  - To satisfy the split opinion of the user community, FCDRs should preferably provide three data representations that are internally convertible, i.e.:
    1. Raw counts
       - *original counts and associated auxiliary data/measurements*
    2. Sensor-equivalent harmonisation
       - *keeping the monitored instruments' characteristics*
    3. Reference-sensor equivalent homogenisation
       - *pretending it behaves like the reference sensor*

- Action: GCC to coordinate input from GPRCs to attempt to identify at least one user for NRT, RAC and climate applications and interact with users to establish draft user requirements.
- Action: Tim Hewison to resolve use of GSICS products for Meteosat IR with FIDUCEO.

Interaction with other groups

Joint GRWG-UVSG and CEOS WGCV-ACSG Meeting

- Joint GSICS Research Working Group UV Sub-Group (GRWG-UVSG) and CEOS Working Group on Calibration and Validation - Atmospheric Composition Sub-Group (CEOS WGCV-ACSG) meeting
  - ✓ NOAA/NCWCP, College Park, MD, on the 8th and 9th October 2015
- Organised around a set of questions which form the basis of a user survey designed to assess the most appropriate focus for the GSICS sub-group activities:
  - ✓ internal measurements, internal consistency methods, measurement characterizations, external methods and measurements, external resources etc

Joint GRWG and CEOS WGCV for the climate monitoring

- [Action] The GRWG Chair to invite the CEOS WGCV to work on a joint statement on procedures, best practices and calibration resources required to ensure consistency of data records through accurate and homogeneous calibration, as an input to the Architecture for Climate Monitoring from Space