



GSICS MW SubGroup

22 May 2018 – 1100-1230 UTC

GSICS Microwave Sub-Group web meeting
Tuesday, 22 May 2018
1100 UTC
Meeting number (access code): 954 701 351
Host key: 880567
Meeting password: gsics

<https://eumetsat.webex.com/eumetsat/j.php?MTID=m0f5756b5a6aad50ece70252bf245fa79>

Join by phone

Global call-in numbers: <https://eumetsat.webex.com/eumetsat/globalcallin.php>



Agenda for Today

1. Welcome, new members and general business (Ralph) (5 min)
2. Last meeting action items – most have been closed – no discussion
3. Status of **OPEN** 2017 GDWG+GRWG Action Items (20 min)
 - GMW2017.6f.2 - GRUAN (T. Reale)
 - GMW2017.6g.1 – MW RTM comparison (I. Moradi)
4. Outcome of the 2018 GRWG+GDWG Annual Meeting; New Actions – (R. Ferraro) (35 min)
5. Science/Agency Reports (15 min each)
 - MW Data Assimilation at CMA and connection to GSICS – (Q. Liu)
 - MW Radiometer Constellation/Gap – (T. Hewison)
6. AOB, wrap up, next meetings, etc. (5 min)



Members

Signed up as of April 2018

- ❖ NOAA (and affiliates) - Ralph Ferraro (Chair), Huan Meng, Cheng-Zhi Zou, Tony Reale, Mark Liu, Manik Bali (Univ. Maryland), Isaac Moradi (Univ. Maryland), Hu ("Tiger) Yang (Univ. Maryland), Wenze Yang (Univ. Maryland), Johnny Luo (City College New York), Xailei Zou (Univ. Maryland), Lin Lin (Univ. Maryland), John Yang (Univ. Maryland)
- ❖ EUMETSAT (and affiliates) – Tim Hewison, Karsten Fennig, Viju John, Jörg Ackermann, Sabatino DiMichele, Sante Laviola, Vinia Mattoli, Sreerexha Thonippambil, Christophe Accadia, **Timo Hanschmann**, Martin Burgdorf (Hamburg Univ.), Imke Hans (Hamburg), Ralf Bennartz (Vanderbilt Univ.), **Bruno Picard (CLS)**
- ❖ NASA (and affiliates) – Ed Kim (GSFC), Tanvir Islam (JPL), Linwood Jones (Univ. of Central Florida), Rachael Kroodsma (Univ. of Maryland), Wes Berg (Colorado State Univ.), Thomas Holmes (GSFC)
- ❖ NIST – Derek Houtz, David Walker, Dazhen Gu
- ❖ ECMWF – Steve English, Heather Lawrence
- ❖ CMA (and affiliates) – Songyan Gu, Qifeng Lu, Lin Chen, Hu Yang, Xiaolong Dong, Shengli Wu, Xiuqing Hu
- ❖ KMA (and affiliates) – Jun Park, Dong-Bin Shin (Yonsei University, South Korea), Dohyeong Kim, Minju Gu
- ❖ JAXA (and affiliates) - Misako Kachi, Takashi Maeda
- ❖ IISC – Ram Ratan



Previous Action Items

Action Id	Item	Summary	Lead	What to Do	Expected Completion	Actual Completion	Deliverable Usage	Status
A.GMW.2017.6b.1	ATMS on JPSS-1	Provide an update on the status after launch (currently Sept 2017)	Ed Kim	Information	2017-12-01	2018-01-12	Information	CLOSED
A.GMW.2017.6c.1	Microwave imager CDR	Determine feasibility of extracting the inter-calibration algorithms and coefficients from the FCDR and making them a GSICS product.	Karsten Fennig	Analysis	2018-03-01	2018-03-01		CLOSED (see A.GMW.2017072 5.2)
A.GMW.2017.6d.1	Microwave sounder CDR	Determine feasibility of extracting the inter-calibration algorithms and coefficients from the FCDR and making them a GSICS product.	Cheng-Zhi Zou	Analysis	2018-03-01	2018-03-01		CLOSED (see A.GMW.2017072 5.2)
A.GMW.2017.6f.1	MW Sensor inventory	MW Subgroup chair to develop candidate satellite/sensor (inventory), perhaps in the form of a graphical aid, as in orbit references for specific channels (based on some predetermined set of parameters that Manik has outlined...) and note pros and cons, other attributes (publications, etc.)? It should include timelines of sensors and overlap periods.	Jun Park	Information	2018-03-01	2018-03-01	Information	CLOSED
A.GMW.2017.6f.2	GRUAN Study	Tony Reale (NOAA) to provide a draft uncertainty analysis describing the comparison of example (microwave) instruments to GRUAN sondes.	Tony Reale	Analysis	2018-03-01			Open
A.GMW.2017.6g.1	MW RTM comparison	MW co-chair to develop set of specific tasks to be performed by the Subgroup to intercompare RTM output over static references and surface models. Tasks to be identified within 6 months (Sep. 2017).	Isaac Moradi	Information	2018-08-01			Open
A.GMW.2017.5g.1	MW Naming Convention/Metadata	MW subgroup would contact NOAA GDWG to get support for product creation if needed.	Ralph Ferraro	Tech Support	2018-03-01			Open
R.GMW.2017.6a.1	MW Lunar Calibration	Get an update from Martin in approx. 6 months.	Martin Burgdorf	Information	2017-09-30	2017-10-12	Information	CLOSED
R.GMW.2017.6e.1	NIST calibration reference	Get an update from Derek in approx. 6 months.	Derek Houtz	Information	2017-09-30	2018-01-12	Information	CLOSED

[EP-18.02] GRWG to assess the utilization RO for microwave instrument monitoring purposes

- We have held several meetings and developed a white paper to close out this action
- This will be a specific topic at the Thurs/MW subgroup meeting



<http://gsics.atmos.umd.edu/bin/view/Development/20180319>





Agenda - Overview

- ❖ Day 1
 - Mini-conference
 - Plenary reports – GSICS Agencies
- ❖ Day 2
 - Plenary reports – GDWG and GRWG (and subgroups)
 - Plenary reports – Special topics
- ❖ Day 3
 - Subgroup parallel sessions
- ❖ Day 4
 - Subgroup parallel sessions
- ❖ Day 5
 - Plenary/Wrap Up



Feedback - Plenary

- ❖ GRUAN activities will be included in Peng Zhang's (CMA) annual report to GCOS
- ❖ GRWG – We need to see some true MW products/deliverables in upcoming year!
- ❖ Most WG's have vice-chairs – we are pleased to announce that Qifeng Lu (CMA) will serve in this capacity!
- ❖ Satellites in stable orbits like S-NPP/N20 and the MetOp series should be exploited to do intercalibration and considered as references



2018 MW Session

Thu pm		GRWG: MW Sub-Group			
		Chair : Ralph Ferraro			
13:00	Ralph Ferraro	NOAA	Introduction and Action Item/Discussion	9a	0:30
13:30	Shenli Wu	CMA	Development of FY-3/MWRI Calibration on warm/cold targets and reflector emissivity	9b	0:20
13:50	Yang Guo	CMA	Calibration and validation of Microwave Humidity Sounder onboard FY-3D satellite	9c	0:20
14:10	Hao Liu	NSSC	Consideration of the on-board calibration of interferometric synthetic aperture microwave radiometer,	9d	0:20
14:30	Xiaolong Dong	NSSC	Development and Standardization of the Guidelines for Prelaunch Calibration of Microwave Sensors - Activities of the CEOS WGCV	9e	0:20
14:50	Ninghai Sun	NOAA Affiliate	ATMS SDR NOAA-20 and NPP ATMS calibration update	9f	0:20
15:10	Coffee break				0:20
15:30	Ralph Ferraro	NOAA	Introduction: Radio Occultation as a MW standard/calibration source	9g	0:10
15:40	Lin Lin	NOAA Affiliate	Mutual Validations of Observations between lifetime S-NPP ATMS and GPS ROs from COSMIC, MetOp and KOMPSAT (Provided by Xiaolei Zou)	9h	0:15
15:55	All		RO Discussion	9i	0:30
16:25	Scott Hu	CMA	ATMS Cal/Val evaluation using FY-3C/GNOS profile standard	9j	0:15
16:40	Manik Bali	NOAA Affiliate	Proposed Best Practices	9k	0:30
17:10	Ralph Ferraro	NOAA	NASA GPM X-Cal Updates (provided by Wes Berg and Rachel Kroodsma)	9l	0:20
17:30	Manik Bali	NOAA Affiliate	GRUAN (Provided by Tony Reale)	9m	0:30



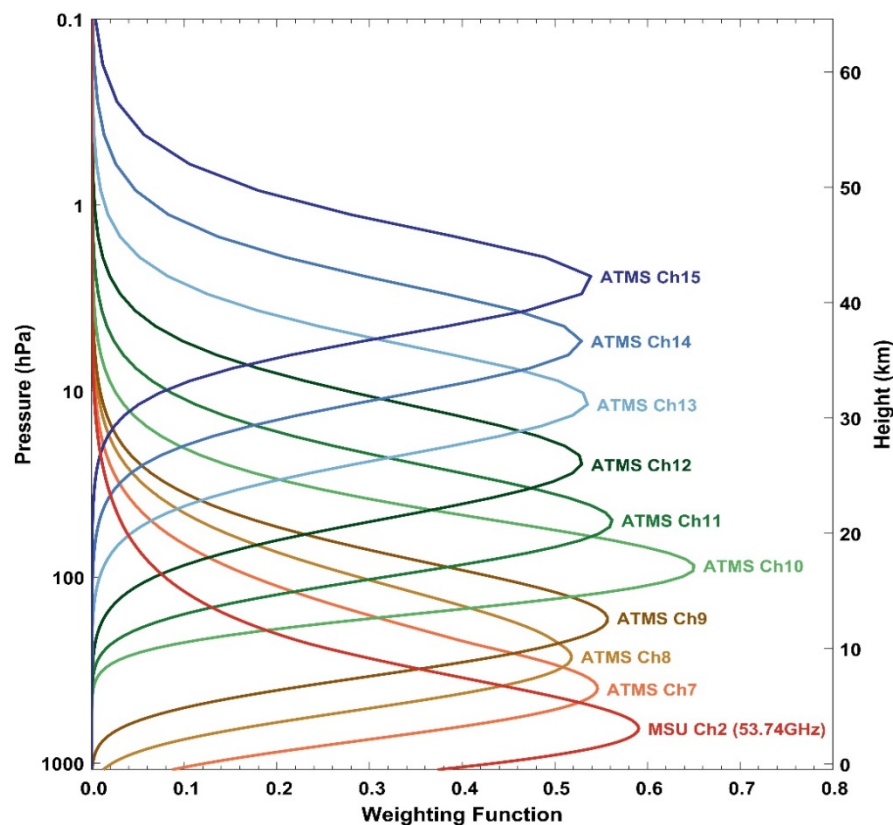
MW Session (1/3)

- ❖ We learned a lot about **China's MW sensors**, operational and development
 - Development of **FY-3/MWRI Calibration** on Warm Target and Reflector Emissivity
 - ✓ After the Warm Target correction, stability of the Gains of MWRI's 10 channels are significant improved.
 - ✓ Reflector correction reduced the ascending/descending Bias from 1~2K to less than 0.1K.
 - Calibration and validation of **microwave Humidity sounder onboard FY-3D satellite**
 - ✓ FY-3D MWHS(II) on-orbit calibration system has been working well, and the basic calibration data are stable.
 - ✓ The NEDT of FY-3D MWHS(II) is well characterized and meets the specification.
 - ✓ Assessments of FY-3D MWHS(II) performance will using NWP O-B and site calibration test data.
 - Use of **FY-3C/GNOS** data for assessing orbit performance of MW sounding instruments
 - ✓ FY-3C GNOS data quality is very good for many applications, including establishing an on-orbit truth for microwave sounder calibration
 - ✓ ATMS bias characteristics with respect to GNOS simulations are very similar to those derived from COSMICS
 - ✓ FY-3C/3D will have two GNOS and more RO profiles will be derived through other GNSS systems such as Beidou (BDS) and Galileo.
- ❖ **MW vice-chair identified – Qifeng Lu, CMA**

MW Session (2/3)



- ❖ Discussed potential best practices, focusing on more in depth activities leading the deliverables in the upcoming year
- ❖ GPS-RO as potential reference for certain O₂ bands
 - We recommend the use of RO data as a reference source to monitor NOAA microwave and infrared temperature sounding data (i.e L1B) for upper tropospheric and lower stratospheric channels (5-25km)
 - These channels include AMSU-A channels 8-11 and ATMS channels 9-12 where moisture effects and instrument noise are negligible. Best cases are for AMSU-A channels 9-10 and ATMS channels 10-11 (see right figure)
 - This could be established as part of the NOAA CAL/VAL plan with assistance from GSICS in the analysis of the monitoring results. The technology to perform this monitoring is already available at NOAA/STAR
 - This includes the capability of finding collocations between RO and NOAA satellites, assessing the RO temperature profiles and converting these profiles into channel-equivalent radiances for both microwave and infrared sounders using Community Radiative Transfer Model (CRTM) simulations



ATMS and AMSU-A weighting function



MW Session (3/3) – Some feedback

- ❖ Joint GSCIS-CEOS work – ISO/TS-19159 for MW – Cheng-Zhi?
- ❖ Hold GSCIS session at IPWG-9
- ❖ Joint agency work via GPSRO – CMA and NOAA for starters – other channels that GPSRO could be used for?
- ❖ A lot on best practices...
 - In orbit references
 - SNO best practices (IR already did this?)
 - What does GPM X-Cal do?



New Actions

A.GMW.2018.9a.1: Manik Bali to talk with Cheng–Zhi Zou to see if diurnal affects are included in his CDR. If the answer is no, then it is a candidate for a GSICS product

A.GMW.2018.9e.1: GSICS (C. Zou, Q. Lu) and CEOS WGVC (X. Dong) to coordinate on best practice for MW Sensors and coordinate on the development of a MW ISO sensor document (similar to other wavelengths) lead by Dong's group

A.GMW.2018.9g.1: GPSRO focal points (X. Zou/Lin and S. Hu) to further evaluate their results for effects of cloud water and cloud ice and report back to the group within 6 months.

There were a series of actions in regard to a best practices matrix that Manik showed (see next slide) – these were actions that resulted from that discussion:

A.GMW.2018.9k.1: In order to determine best practice for pre and post-launch best practices and share with MW members.

A.GMW.2018.9k.2: Manik will survey existing satellite operator monitoring pages and present finding within 6 months.

A.GMW.2018.9k.3: Manik will ask around to find these websites and make them available. He proposed MW group an action on best practices for SNO collocation criteria, e.g. how to pair the pixels, what is the pixel distance, what is the time difference.

A.GMW.2018.9k.4: Check IR group's GSICS product ATBD and do some survey in the literature on how SNO has been done for imager, sounding, water vapor channels. He proposed an action of using AMSU/MSU FCDR as MW in -orbit reference.

A.GMW.2018.9k.5: To determine if the NOAA CDR (MSU/AMSU/ATMS) is a viable in-orbit reference, Zou and Bali will report back to the group after a forthcoming paper is published.

A.GMW.2018.9l.1: Collect and document "best practices" to see if GMI can serve as an in-orbit reference. (Ralph Ferraro and Wes Berg).



Pre-Launch Best Practices

Proposed Best Practice Matrix for Pre-Launch Characterization

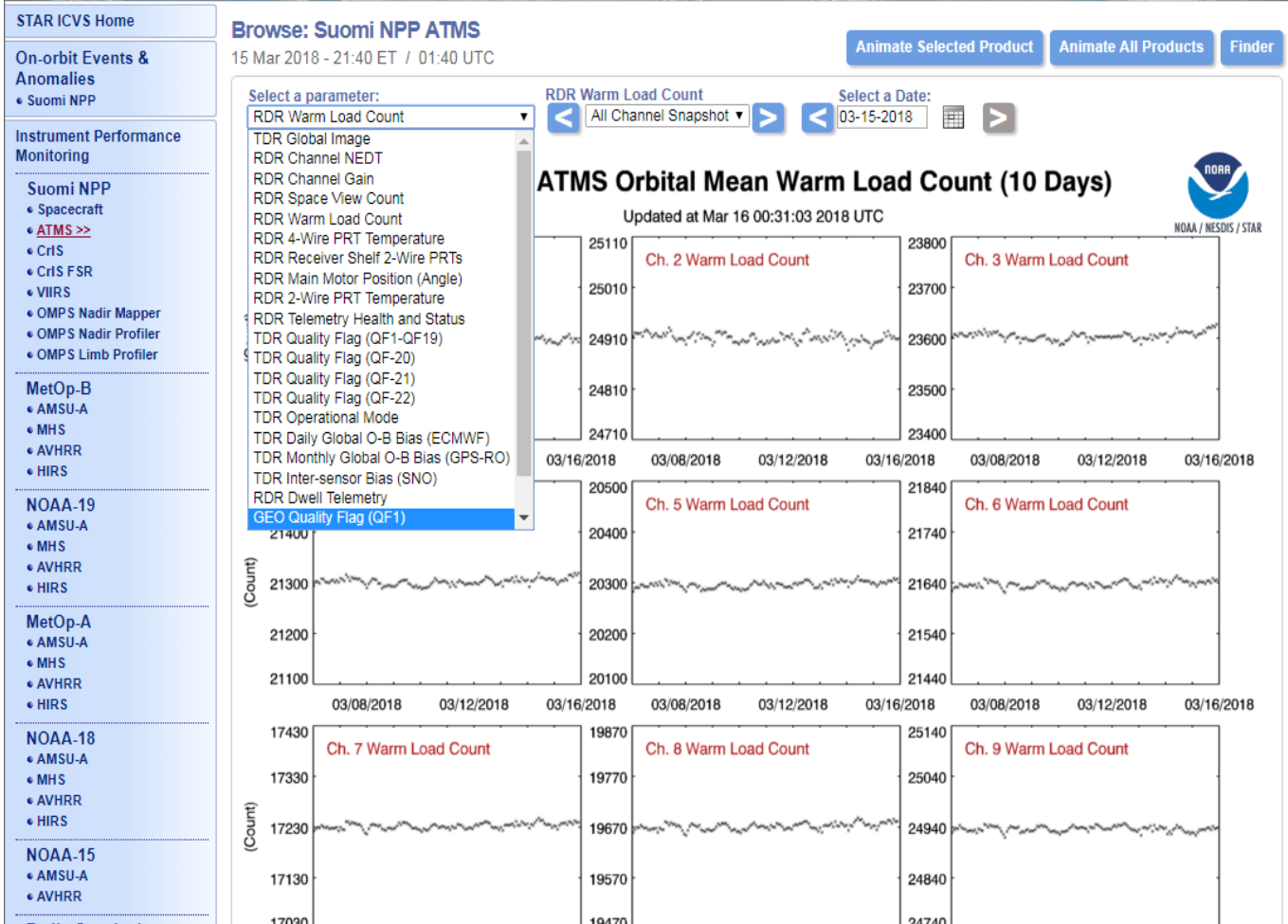
1. Detector Characteristics (Freq, Side Lobe, Response)
2. Non Linearity -> What is your instrument's non linearity
3. Antenna Pattern Correction-> How do you correct for antenna
4. NEdT-> What is your measure of noise .. Can we agree on one standard ?
5. Internal Calibration Targets are Characterized to SI Standards-> What standards do you follow.
6. How do you characterize the Space View at Pre-Launch
7. What is your absolute accuracy estimate and does it meet specs

Proposed Action: Members to share pre-launch Matrix information in the Microwave Subgroup

Post-Launch: Onboard Health Monitoring



STAR ICVS Integrated Calibration / Validation System Long-Term Monitoring
Monitoring and characterizing satellite instrument performance for weather, climate and environmental applications



Best Practice

Monitoring Array of instrument health parameters needs to be monitored on a daily basis and anomalies on websites such as the ICVS (Integrated Calibration/Validation System Long-Term Monitoring)

Post-Launch: Simultaneous Nadir Overpass

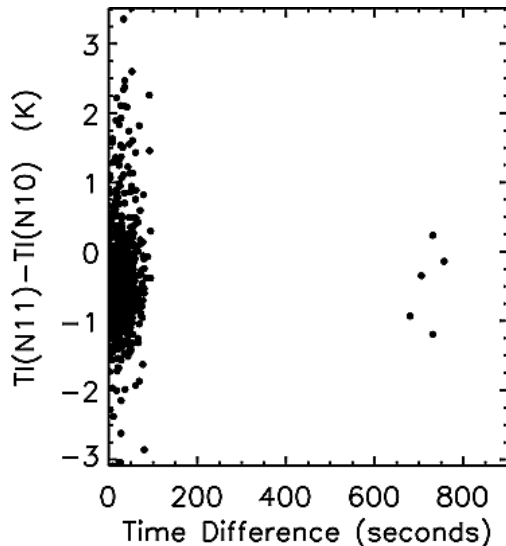


SNO (Simultaneous Nadir Overpass) Algorithm identifies locations observed by two instruments under similar viewing conditions.

This algorithm is used to monitor In-orbit Microwave Instruments.

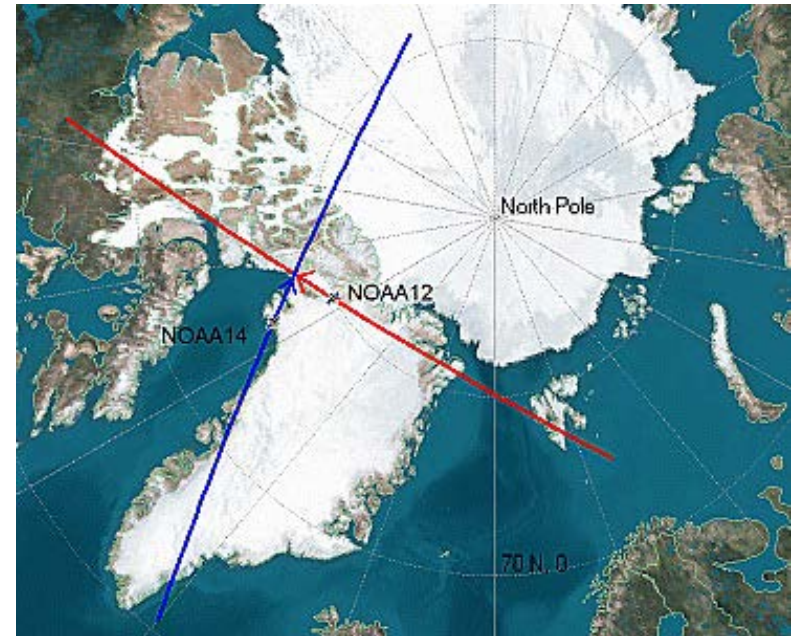
Inter-comparing MW instruments reveals biases anomalies and Trends in instruments.

SNO matchups can accurately determine the differences of the offsets as well as the nonlinear coefficients between satellite pairs, thus providing a strong constraint to link calibration coefficients of different satellites together.



MSU channel 2 brightness temperature differences of the nadir pixels between NOAA 10 and 11 versus time window for the SNO matchups. The maximum spatial distance for the SNOs is set to 111 km. Note that when the time difference is larger than about 100 s, only few SNO data pairs can be found. The brightness temperature is computed from the linear calibration algorithm [equation \(9\)](#). (Zou et al 2006)

SNO Code from Cheng-Zhi Zou can be shared in the MW Subgroup



e.g for Oxygen bands Best Practice for SNO

- Measurements within 111 Km spatial distance
- Measurements taken within a 100 Seconds of each other
- Measurements taken within 1 degree of Scan Angle Difference

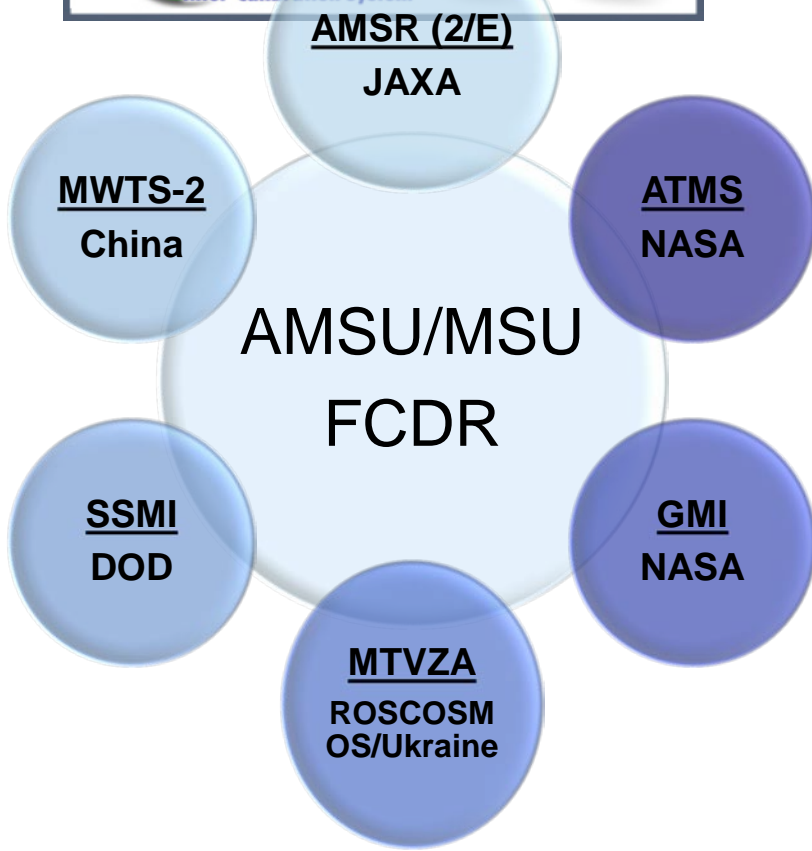
(Zou et al. 2006).

Proposed Action

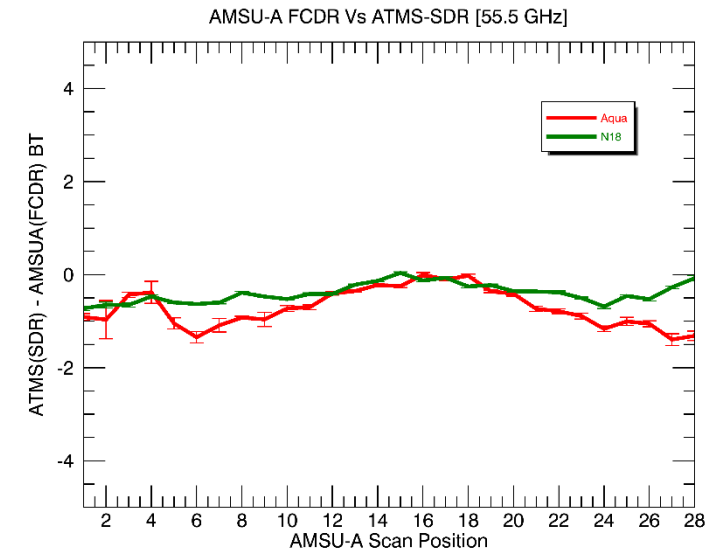
GSICS Agency Report

Should we have an exercise across MW group to propose best practices may vary with window, Oxygen and Water Vapor bands

Post Launch: Best Practice in selecting in-orbit Microwave Reference Record



Central frequency (GHz)	Bandwidth (MHz)
23.800	270
31.400	180
50.300	180
52.800	400
53.596 ± 0.115	170
54.400	400
54.940	400
55.500	330
$f_0 = 57.290344$	330
$f_0 \pm 0.217$	78
$f_0 \pm 0.3222 \pm 0.048$	36
$f_0 \pm 0.3222 \pm 0.022$	16
$f_0 \pm 0.3222 \pm 0.010$	8
$f_0 \pm 0.3222 \pm 0.0045$	3
89.000	6000



FCDR Vs ATMS interc-omparison reveals full scale of scan angle bias in ATMS. Bias is low

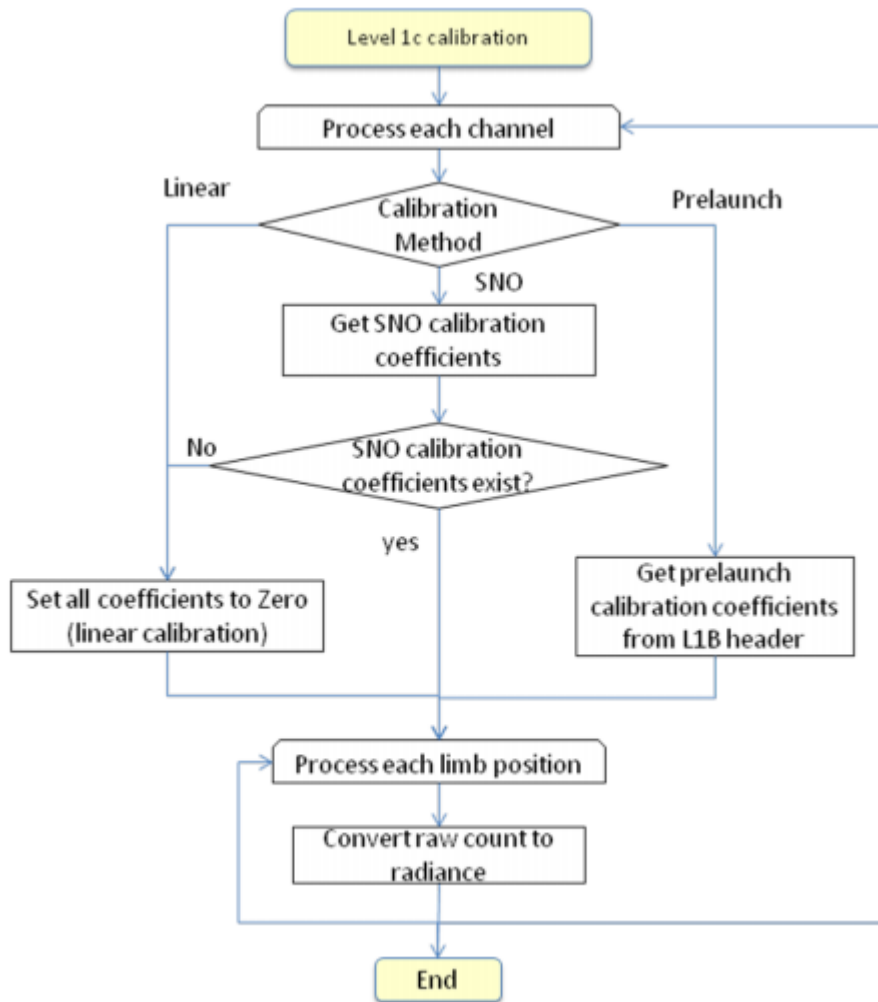
Best Practice for a L1B record to be used as a reference

1. Record to be many times over more stable than monitored instrument
2. Inter-satellite Biases of reference records to be better than 0.1-0.2K
3. Reference record to resemble a typical orbit file
4. Reference Record to be able to provide measurements at all scan angles

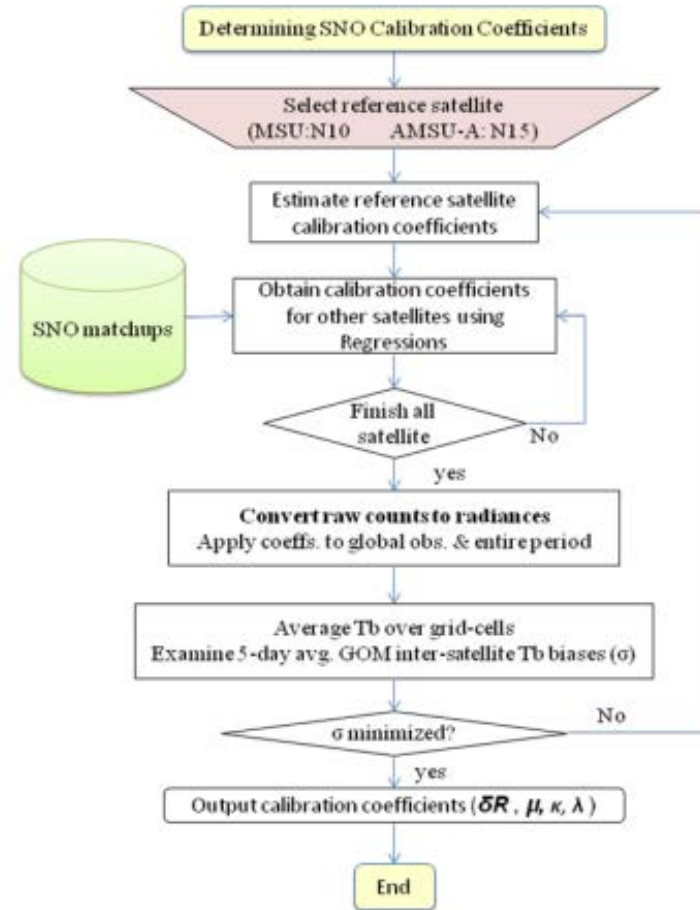
MSU/AMSU-A FCDR channels overlap with majority of MW instrument channels and has been shown to act as an effective in-orbit reference for Microwave Instruments

GSICS Agency Report

Post-Launch: Best Practices in Recalibration



Flowchart of the MSU/AMSU-A level-1c calibration.



Sequential procedure for determining MSU/AMSU-A calibration coefficients.

Flowcharts from AMSU/FCU FCDR ATBD (Zou et al 2006) show the two main steps of Re-Calibration that can be Best Practices for Re-Calibration

List of Best Practices Algorithms and Data sets available on request



- ❖ Simultaneous Nadir Overpass
- ❖ Threshold Values for SNO
- ❖ Re-Calibration and Climate Data Record Generation
- ❖ Onboard Health parameters ATMS via the ICVS
- ❖ In-Orbit References for AMSU/MSU Channels for 183 GHz
- ❖ Framework of Re-Calibration
- ❖ Lunar Reference light curves
- ❖ Best Practices for GPSRO, RTM and GRUAN Sites (*Your views needed*)
- ❖ White paper on GPSRO-Microwave Sounder and GRUAN-MW CDR comparison is available for the community to follow

Summary



- ❖ The GSICS Microwave Subgroup has moved ahead in identifying algorithms that it can share with the Microwave Community and can be treated as community best Practices.
- ❖ The Algorithms are related to
 - Pre-Launch Calibration
 - Post Launch Calibration
 - In-Orbit Reference Selection
 - Re-Calibration
 - Lunar Data Sets in MW wavelength ?
- ❖ We invite you to use these and contribute to sharing.
- ❖ A Wiki Workspace Page has also been established for Data Sharing (<http://gsics.atmos.umd.edu/bin/view/Development/MicrowaveSubGroup>)

Backup Slides

Scope of Microwave Sub-Group

- 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
- We should also focus 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 (SSM/I), GPM X-Cal LUT's
- 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 2017-2018

- Defining CLEAR PATH for **GSICS MW products and algorithms**
 - Methodologies (*Jun Park, Rachel Kroodsma*)
 - SNO, Double difference, etc.
 - Reference Standards (*Manik Bali, Isaac Moradi, Derek Houtz*)
 - A particular sensor? Likely to be wavelength dependent (e.g., window, O₂, H₂O); A RTM?
 - LUT/Correction Tables (*Karsten Fennig, Cheng-Zhi Zou, Viju John*)
 - Near real-time and climate; they will be different
- Tying together other groups/opportunities
 - GPM X-Cal (*Wes Berg, Rachel Kroodsma*)
 - CEOS MW subgroup (*Cheng-Zhi, Xiaolong Dong*)
 - Expanding active participation (*Manik Bali, Ralph Ferraro*)
 - GRUAN (*Tony Reale, Cheng-Zhi Zou*)
 - FIDUCEO (*Martin Burgdorf*)
 - GAIA-CLIM (*Heather Lawrence/Steve English*)
- Continued participation **by subgroup** at meetings of relevance:
 - GSICS; CEOS; CALCON, Microrad, AMS Sat. Met, EUMESAT Satellite, etc.