



Minutes of the 2022 Annual GSICS Joint Working Groups Meeting 14 – 18 March 2022**, Virtual

***10 March 2022 UVNS Breakout*



GSICS WGs – 2022 Minutes

Action: in red, Recommendation: in green, Decision: in blue

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GSICS WGs – 2022 Minutes

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Plenary Mini Conference – AM on 14th March, 2022	
Chair	Fangfang Yu
Minute Taker	Tim Hewison and Xiuqing “Scott” Hu
Attendance	
Remote Attendance	

Agenda Item: 1a Welcome	
Presenter	Mitch Goldberg
Overview	Mitch opened the 2022 Annual Meeting of the GSICS Working Groups and welcomed the participants of the Mini Conference.
Discussion point, conclusions, Actions, Recommendations, Decisions	
None	

Agenda Item: 1b Introductions, agenda and minute taking	
Presenter	Fangfang Yu
Overview	Fangfang welcomed the participants of the Mini Conference, pointing out it is the first full Mini Conference since 2019
Discussion point, conclusions, Actions, Recommendations, Decisions	
Minutes are being taken in this document, and minute takers are identified in the agenda.	

Agenda Item: 1c Feedback between GSICS and NWP Community on Radiometric and Spectral Biases	
Presenter	Tim Hewison (EUMETSAT)
Overview	Tim introduced GSICS and its current products. He explained that GSICS monitor biases by inter-comparisons with reference sensors to provide information on satellite instruments’ biases. Current GSICS corrections are provided in Radiance-space - even for biases that may be spectral in origin. Spectral Response Functions may be different in-orbit – these can be modeled – or SRFs shifted so radiances match reference based on one-off investigations – e.g. during commissioning. The prospect of continuous monitoring of SRFs was introduced – e.g. to correct contamination build-up – although this would require retraining fast Radiative Transfer Model used in NWP (to which users were previously reluctant). GSICS could investigate retrieving SRFs in orbit by comparison with hyperspectral reference instruments.
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: Should GSICS develop SRF retrievals?</p> <p>A: It is worth investigating, but priority depends on user demand.</p> <p>A: Xu Na (CMA) et al. recently published a nice paper on SRF retrievals.</p> <p>Propose discussion on SRF retrievals for web meeting</p> <p>Roger Saunders (UKMO) explained that it would be complicated to implement a dynamically variable SRF in the fast model (RTTOV) used at the Met Office – although this could be attempted</p>	

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for a trial period (where computational efficiency less critical).

Q: Account for antenna pattern?

A: Important for microwave instruments – for IR, just account for FOV, by averaging multiple GEO pixels within each LEO FOV.

Agenda Item: 1d Long term monitoring of satellite radiances using the Met Office NWP model

Presenter	Roger Saunders (UK Met Office – retired)
Overview	<p>Monitoring satellite radiances using an NWP model is a useful tool to monitor an instruments health. Changes in the NWP system can introduce changes in the bias (e.g. upper level moisture, upper stratosphere) but the double difference is insensitive to these. The biases for IASI-A and IASI-B are very similar and stable and in general close to zero compared to the model. The scan dependence and scene dependence are identical. The non-linearity corrections applied in Aug 2017 and Sep 2019 are more evident for the CO2 channels and now all 3 IASIs in better agreement. It is clear IASI radiances will make a good Fundamental Climate Data Record. The bias of the CO2 channels on SEVIRI, IASI and AIRS/HIRS (on METOP) are all significantly different from each other (instrument related). For the 6.2µm water vapor channel the biases are different due to different ISRFs but they all vary the same way (model related).</p> <p>The changes in bias of the Meteosat SEVIRI CO2 channel is evident and the impact of decontamination on the bias. The big changes in bias and standard deviation of the HIRS radiances over the past 10 years will require care when creating FCDRs. The O-B bias becomes more positive with increasing scene temperature for all instruments except AATSR which uses 2 internal black bodies for its calibration. The change in bias with scene temperature shows the limitation of the polar SNO method. Improvements in UTH in the Met Office model were demonstrated. Reanalyses are new resource for historical O-B studies.</p>

Discussion point, conclusions, Actions, Recommendations, Decisions

<p>Q: An excellent agreement is shown between the three IASI instruments at 10.5 micron. Are the three IASI instruments calibrated independently? A: (D. Coppens): Yes - they are</p> <p>Q: Impact of sampling different climatology from different instruments? A: Yes – especially for WV channels sampled at different times of day – but difficult to characterize</p> <p>Q: Source of in NWP O-B biases for water vapor? Common wet bias to several NWP models. A: Models have improved, but still have some biases, and do not represent all processes</p> <p>Offline discussion (T. Hewison, D.Doelling): The NWP double-difference inter-calibration method relies on the assumption that all model errors will cancel out, as they should be the same for each sensor. However, in reality this is often not the case – and this is often due to cloud – even when the comparisons are limited to clear sky</p>
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– e.g. different cloud-screening schemes may be applied to instruments of different resolutions, or with different channels. In theory, it would also be possible to perform the double-difference calculation in cloudy conditions too – and this is used for microwave instruments, where clouds are rather more “linear”. But as Leonhard Scheck pointed out, there is valuable signal in the VIS/NIR channels in cloudy conditions – but you would need to ensure the scene is fully cloudy in both sensors, as he did in his O-B statistics – otherwise, the differences are dominated by differences in cloud cover, rather than instrument differences.

Although the NWP double-differences should correctly account for the actual SRF of each instrument. However, something like an SBAF may be needed to compare the results.

The method is not limited to the use of NWP climate reanalysis datasets – although in that case the above model errors should be more constant with time than when using an NWP model used for real-time forecasts, as these are regularly changed – as Roger showed.

Agenda Item: 1e Using visible and near-infrared channels in NWP

Presenter | Leonhard Scheck (DWD)

Overview | University of Munich started developing forward model operator for VIS/NIR channels to allow NWP model to exploit additional info available – e.g. cloud phase, particle size and aerosol. Challenges include multiple scattering and 3D effects (even that is progressing).
MFASIS uses a strongly simplified model (e.g. single cloud layer), with 8 parameters
Can generate LUTs, which can be compressed to 21MB and are fast for operational use.
LUT approach works well for 0.6 μ m and 0.8 μ m channels, but not 1.6 μ m channel due to multiple scattering introducing dependence on effective radii and strong sensitivity to ice and trace gases. Similar issues restrict application to multiple aerosol parameters.
Successfully replaced LUT with ANN – and only need 8MB of training data (cf 8GB for LUT) - and can include adjoint and tangent linear outputs. Even works ok for 1.6 μ m.
Obs-Model shows importance of tuning sub-grid clouds based on 0.6+10.8 μ m obs.
Assimilation trials showed 0.6 μ m SEVIRI could reduce error in biased backgrounds.
O-B statistics follow superposition of 2 gaussians – for clear sky and cloud
Importance of cloud inhomogeneities still TBD.

Discussion point, conclusions, Actions, Recommendations, Decisions

Q: How sensitive to biases in SEVIRI 0.6 μ m and 0.8 μ m?

A: Used Meirink et al 2013 to apply bias correction – can exchange offline

Q: Any studies on ABI/AHI - in particular additional channels?

A: No – but will look at FCI. ECMWF have on OLCI and AHI. 0.8 μ m channel on FCI should be better (narrower)

Q: Extra channels on newer GEO imagers.

Q: can you treat inhomogeneous O-B statistics in assimilation?

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A: Can just exclude cases when O and B are both clear – not expected to have impact

Agenda Item: 1f Discussion

Presenter

Overview

Discussion point, conclusions, Actions, Recommendations, Decisions

Q: interaction with NWP-GSICS on time-dependent VIS/NIR calibration?

A: Already apply bias correction – could cooperate with GSICS on dynamic bias correction. typical calibration stability of ~0.5%/year insignificant compared to other errors.

Q: Focus on direct assimilation – any investigation into assimilation of L2 products?

A: DWD only focus on L1. ECMWF also looking at aerosol affected radiances.

Q: Could retrieve SRF for VIS/NIR channels?

A: EUMETSAT have retrieved dynamic SRF based on different vicarious methods. Could also investigate use of GOME-2 as a hyperspectral reference – see also Viju John's presentation below!

Q: Could use retrieved L2 cloud properties to derive predicted radiances?

A: Has been done by JMA's liquid water cloud based inter-calibration method and another group at NASA.

Q: How to distinguish non-linearity error from SRF errors?

A: They can give similar patterns of bias dependence with scene radiance.

A: Important to use same SRF in NWP

Agenda Item: 1g Group Photo

Presenter

Tim Hewison

Overview

A composite of selected participant's webcam images

Discussion point, conclusions, Actions, Recommendations, Decisions

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Agenda Item: 1h Commissioning test results of FY-3E early morning satellite

Presenter	Xiuqing Hu/Ling Sun (CMA)
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Overview	<p>First operational meteorological satellite in early morning orbit for civilian use.</p> <p>WindRAD – C & Ku-band with VV&HH polarization</p> <p>MWTS-III & MWHS-II – more channels and better noise than MWTS-II – compared SNO with ATMS</p> <p>HIRAS-II: 3x3 detectors, contiguous spectral coverage – compared with CrIS + IASI – SNO <0.3K in LWIR <0.5K in MWIR (O-B DD <0,5K for LWIR and <1.0K for MWIR)</p> <p>MERSI-Low Light – includes solar diffusor + new pan-chromatic low-light band</p> <p>GNSS-RO Sounder-II (GNOS-II)</p> <p>+ 3 Solar Observation Instruments + 2 space weather monitors</p> <p>All have monitoring, many including NWP</p>
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Discussion point, conclusions, Actions, Recommendations, Decisions

Q: Important for characterizing diurnal variations in models and GSICS instruments – have CMA tried to GEO-LEO IR with HIRAS-II?

A: Plan to compare with FY-4/AGRI and GIIRS – look forward to seeing results in IR sub-group

Agenda Item: 1i Radiometric Calibration of Planet's SkySat Fleet using Near-Simultaneous Crossovers with Sentinel-2

Presenter	Hannah Bourne (planet)
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Overview	<p>Hannah introduce the SkySat and Doves fleet and products from Planet.</p> <p>SkySat provides high resolution (0.65m) on-demand images (5 bands).</p> <p>SuperDoves now provide 8 bands 450-900nm – similar to Sentinel-2.</p> <ul style="list-style-type: none"> - Comparisons with Sentinel-2 don't rely on Spectral Band Adjustment Factors. <p>Previously, used RadCalNet + modelled TOA radiances.</p> <p>Near-simultaneous = within 2hr over pre-defined PICS, near nadir (<20°),</p> <ul style="list-style-type: none"> - characterized by Hyperion to define SBAF - Derive gain and offset on a per-satellite basis - Also use lunar monitoring
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Discussion point, conclusions, Actions, Recommendations, Decisions

Q: SRFs of SuperDoves look very close to boxcar response – was there a requirement?

A: will check

Q: How much variations between the calibration coefficients of different SkySat satellite?

A: Good amount of variation between RadCalNet + S-2 – can get back with stats before/after S-2 inter-calibration.

Q: how many lunar views?

A: task each satellite to observe Moon 3x per month – not all used.

Lunar calibration of Planet Labs satellites will be presented in monthly meeting

Q: Differences between SRFs?

A: Planet hope to make SRFs publicly available

Q: Variations on SBAF with view angle, WV burden, etc?

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A: Usually limit view angle range – will investigate impact on view angle.

Q: How often do you update?

A: Doves – every 6m – easy for Doves. Approach is new for SkySat, but hope to target 6m.

Agenda Item: 1j "Harmonization" and "Homogenization"

Presenter	Viju John (EUMETSAT)
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Overview	Viju explained the difference between the inter-calibration approaches described as “harmonization” and “homogenization”. Current GSICS Corrections perform harmonization. Many FCDRs use homogenization to combine CDRs from multiple instruments. He introduced the harmonized products from Meteosat/MVIRI VIS0.6 channel, based on SRFs retrieved from different PICS, and outlined how these were validated using SCIAMACHY observations. He contrasted this with a microwave FCDR for 183±1GHz channels of different sensors
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Discussion point, conclusions, Actions, Recommendations, Decisions

Q: since harmonization does not force different sensors to be same, is pre-calibrated data already a harmonized data record by nature?

A: yes if both/all are SI-traceable and correctly done - and time invariant and perhaps something more. Otherwise, onboard characterization is needed.

Q: Standard Deviation of bias can also show important performance differences (e.g. HIRS)

A: Yes – also checked!

Comment: Use of SCIAMACHY to validate SRF retrievals from Meteosat/MVIRI - see discussion above.

Agenda Item: 1k GSICS Harmonization at NOAA and its Implementation for ABI

Presenter	Fred Wu (NOAA)
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Overview	<p>Fred recalled the development of the current GSICS Corrections – and their name.</p> <p>Time to revisit this name – e.g. some GEO may be as well calibrated as LEOs</p> <p>Re-focus GSICS to quantify differences among radiances from different sensors.</p> <p>He proposed “GSICS Harmonization” as a more neutral terms without prejudice.</p> <p>NOAA now generating NRTH and RAH products for ABI – still to check consistence.</p> <p>Will follow 3-tier approach: prelaunch, last, current and allow users to opt in</p>
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Discussion point, conclusions, Actions, Recommendations, Decisions

Q: Equations still relate R_GEO as a function of R_LEO – same for all pixels?

A: Due to regression used in comparison of collocations – yes – same for all

Q: When we develop new GSICS products, should move away from fixed a,b coefficients?

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A: Yes – can do. Could also invert relationship (supported by Viju John)

Q: correction and harmonization seem to imply adjustments to bring to a standard reference.

Where do uncertainties fit into the name? (R. Iacovazzi)

Raw could be ops and reprocessed

A: (offline)

Q: will NOAA operations use the GSICS numbers for L2? (A. Heidinger)

A: (offline)

L. Flynn: GSICS Correction should continue to be the term when comparison results are with respect to GSICS References.

Agenda Item: 1I ISCCP NG Status

Presenter	Andy Heidinger (NOAA)
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Overview	Andy outlined aims of ISCCP-NG and prototype L1g products, with GSICS calibration coefficients embedded (with other options). L2 activities through International Cloud Working Group (ICWG) as a test bed. Aim to provide feedback on GSICS products.
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Discussion point, conclusions, Actions, Recommendations, Decisions

A.GWG.20220314.1: Tim Hewison (EUMETSAT) to provide Tech Note providing guidance on how to apply GSICS Correction for GEO imagers to Andy Heidinger to request feedback - done! Tech Note distributed to gsics-dev in [this email](#).

Q: What plans to go back in time with ISCCP-NG?

A: Need to establish plan way forward – focusing on getting ready for MTG-FCI, then backward in time – being coordinated by Jörg Schulz.

A.GWG.20220314.2: Andy Heidinger to put the link to the ISCCP-NG page in the minutes!

cimss.ssec.wisc.edu/isccp-ng

Plenary Agency Reports Session: 15 March 2022

Chair	Xiuqing “Scott” Hu / Fangfang Yu
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Minute Taker	Tim Hewison
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Attendance	
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Remote Attendance	CMA: Chengli Qi, Tian Lin, Ling Sun, Scott Hu, Yong Zhang, Yuan Li
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CNES: Clémence Pierangelo

ESA: Philippe Goryl, Pablo Castracane, Silvia Scifoni, Berit Ahlers, Fabrizio Niro

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	<p>EUMETSAT: Tim Hewison, Dorothee Coppens, Sebastien Wagner, Viju John, Alessandra Cacciari</p> <p>IMD: AK Mitra, Kavita Navria</p> <p>ISRO: Nitant Dube, Munn Shukla, Pradeep Thapliyal</p> <p>JAXA: Misako Kachi</p> <p>JMA: Arata Okuyama, Kazuki Kodera, Kazutaka Yamada, Kozo Okamoto, Misaki Eiki</p> <p>KMA: Hyelim Yoo, Jiyoung Kim, Eunkyoo Kim, Yoon Cheoi Kim, Junho Kim</p> <p>MOES: Kamaljit</p> <p>NASA: Ben Scarino, Conor Haney, Jack Xiong, Jason Choi, Raj Bhatt, Dave Doelling</p> <p>NICT: Tsutomu Nagatsuma</p> <p>NOAA: Fangfang Yu, Larry Flynn, Likun Wang, Lin Lin, Robbie Iacovazzi, Cheng-Zhi Zou, Jun Zhou, Manik Bali</p> <p>USGS: Hugh Kieffer (now Celestial Reasonings), Tom Stone</p> <p>WMO: Heikki Pohjola, Ken Holmlund</p> <p>Unknown: Stuart Phinn</p>
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Agenda Item: 2a JMA Agency Report

Presenter	Arata Okuyama
Overview	<p>JMA have implemented ray-matching inter-calibration for AHI-VIIRS. Vicarious Calibration will update to JRA-3Q new reanalysis project.</p> <ul style="list-style-type: none"> - Impact: <0.3% difference <p>Himawari-9 will start operations towards end 2022.</p> <ul style="list-style-type: none"> - Now planning follow on <p>VNIR now includes GEO-GEO (since 2018)</p>

Discussion point, conclusions, Actions, Recommendations, Decisions

<p>Q: Any lunar calibration results?</p> <p>A: Yes – but no slides – results are consistent with other approaches</p> <p>Q: Do Himawari9-8 GEO-GEO results consistent with GEO-LEO IR results ?</p> <p>A: Yes – biases of ~0.2K in 6.9µm and 13.3µm channels</p> <p>Q: What are the uncertainties of DCC, GEO-GEO, GEO-LEO and Vicarious Cal?</p> <p>A: would need to check</p> <p>Q: What is the time difference in AHI-8, AHI-9 observations?</p> <p>A: both H8 and H9 observe every 10 minutes, the times are same, such as 00:00, 00:10, 00:20, ...</p> <p>Q: Could you outline why JMA use reanalysis in the vicarious calibration, rather than forecast model data, which would be available in NRT?</p> <p>A: "Reanalysis" may not be a good expression. It is near real time dataset processed by a same algorithm of JRA-55 (or -3Q). The operational forecast dataset changes its processing algorithm, but the "reanalysis" dataset keep to be processed by an algorithm. It's preferable for our approach.</p>	
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Agenda Item: 2b JAXA Agency Report

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Presenter	Misako Kachi
Overview	<p>GCOM-C/SGLI lunar calibration updated and provided to GIRO</p> <ul style="list-style-type: none"> - Also for GOSAT-2/CAI-2 <p>Implemented new CEOS recommended Solar Spectral Irradiance Spectrum (TSIS) - slightly more consistent results in vicarious calibration</p> <p>AMSR3 includes some channel changes cf GOSAT-GW (incl to avoid 5G RFI)</p> <p>Many other slides include status of operational missions</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
Comment: Thanks to JAXA for providing lunar observations to the GLOD	

Agenda Item: 2c KMA Agency Report

Presenter	Jiyoung Kim
Overview	<p>Generating GEO-LEO IR for GK2A/AMI for NRTC+RAC Demo products</p> <ul style="list-style-type: none"> - Applied gap-filing to use CrIS as reference <p>Updating AMI lunar calibration algorithm + Ray-matching+ new DCC algorithm</p> <ul style="list-style-type: none"> - AMI VNIR channels show seasonal variation
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: Cause of seasonal variation in VNIR channels?</p> <p>A: (Fred): Also found on ABI on both GOES-16 and -17, but not AH1, which uses different elevation angle (to solar diffuser) - may be anomaly in door mechanism, causing bias in BRDF – investigations ongoing</p> <p>Topic for Web Meeting – on seasonal cycle in ABI/AMI VNIR calibration</p> <p>Q: Is the pattern in the GEO-LEO IR bias repeated from different years? (e.g. seasonal cycle)</p> <p>A: similar trend from other channels</p> <p>Q: what is the root cause of the large bias values compared to reference sensor? (slide 7)</p>	

Agenda Item: 2d CNES Agency Report

Presenter	Clémence Pierangelo (moving other activities at CNES)
Overview	<p>IASI-B and -C stable – still <<0.1K</p> <p>IASI-A EOL tests presented in IR session.</p> <p>Lunar Calibration for inter-calibration of IASI – more acquisitions scheduled for 2021</p> <p>Updated IASI radiometric budget</p> <p>IASI-NG PFM integration & 1st functional tests – first launch expected summer 2024</p> <p>SUMULU – lunar simulator for realistic images of the Moon</p> <p>PICS – error budget updated for OLCI, SLSTR and S2</p> <p>Sun-glint calibration comparison with RAL</p> <p>CCVS – Copernicus Cal/Val Solution – holistic for all Sentinels – https://ccvs.eu</p> <ul style="list-style-type: none"> - Includes preliminary list of recommendations
Discussion point, conclusions, Actions, Recommendations, Decisions	

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Q: thermal model of Moon – radiance or irradiance?

A: radiance at entrance to satellite imager

Q: Saturation problems in thermal observations of Moon surface?

A: Yes – had to change IASI encoding table and view through cold space port

Q: Are you using IASI observations to build model or use for calibration?

A: 2-months was not enough to quantify uncertainty. 24 observations over 2021 should address that

A.GIR.20220315.1: GSICS Infrared subgroup to hold a web meeting on IASI Lunar Calibration

Agenda Item: 2e ISRO Agency Report

Presenter Pradeep Thapliyal

Overview Reviewed status of ISRO GEO and LEO missions

- New Oceansat-3 launching 2022 – similar to Sentine-3

Reviewed GSICS products for INSAT GEO imagers and sounders

- Soon to include IASI-C

- Ray-matching GEO-LEO technique for VIS and SWIR

GDWG activities – including own plotting tool and interface

GEO-LEO IR products show large biases during eclipse periods

Updated points of contact

Discussion point, conclusions, Actions, Recommendations, Decisions

Q: Cause of biases in INSAT-3R during eclipse?

A: related to yaw-flip – may be related to solar heating around midnight

A.GIR.20220315.2: Follow-up on INSAT-3R bias during eclipse season

R.GWG.20220315.1: ISRO to include CrIS and/or HIRAS in GEO-LEO IR to investigate diurnal variations

Agenda Item: 2f IMD Agency Report

Presenter AK Mitra

Overview Reviewed status of IMD GSICS Corrections for INSAT-3D/3DR

Multi-mission validation of multiple L2 products + comparisons with other instruments

Cal/Val campaign in Raan of Katch – including ground station for AOD

Reviewed data supply system & introduced new IMD CALVAL Portal

Discussion point, conclusions, Actions, Recommendations, Decisions

Q: URL for IMD CALVAL Portal?

A: Will be launched next month – to be added to the CEOS Cal/Val portal

(<https://calvalportal.ceos.org>) - via Paolo Castracane (ESA)

Q: Who operate INSAT-3?

A: Joint venture between ISRO and IMD

(ROSCOSMOS and ROSHYDROMET cancelled)

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Agenda Item 2h WMO Report	
Presenter	Heikki Pohjola
Overview	<p>WMO Unified Data Policy – replaced old policies on weather, hydrology and climate</p> <ul style="list-style-type: none"> - Not only meta data <p>No specific position re: provision of data by private sector – but national governments may be obliged to exchange any observation data they outsource – subject to license</p> <p>Analysis of current and near future capabilities – using OSCAR</p> <ul style="list-style-type: none"> - which is continuously updated - Removed GSICS logo under “Instrument status and Calibration” - should be available on Instrument landing page – some still missing – see Rob Roebeling (EUMETSAT)
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: Situation of national governments sharing observations outsourced to private companies?</p> <p>A: depends on the license – e.g. some GNSSRO data cannot be shared</p> <p>Larry: Recommend agencies ensure they retain license to redistribute L1 and derived L2 products</p> <p>Ken Holmlund: CGMS plenary recommended this – even if this restricts data volume</p> <p>Kamaljit: MOES appreciate clarity in data sharing policy</p> <p>Comment: Thanks to WMO for maintaining OSCAR - very valuable resource - agencies are encouraged to establish their instrument landing pages with links to GSICS products</p>	

SITP Agency Report cancelled

Agenda Item: 2i CMA Agency Report	
Presenter	Chengli Qi
Overview	<p>Successful launch of FY-3E and FY-4B – commissioning ongoing</p> <p>FY-3F will carry 3 new instruments for Ozone Monitoring and a Microwave Imager</p> <p>FY-3G will carry 3 new instruments for precipitation – both due to launch 2022/3</p> <p>FY-4A/AGRI IR monitoring confirms stability with no strong seasonal cycle</p> <ul style="list-style-type: none"> - VIS/NIR: Ch1 and Ch2 show some degradation <p>FY-3E/HIRAS validated using NWP O-B and comparison with IASI <0.3K in M/LWIR</p> <ul style="list-style-type: none"> - Weak abs SWIR channel <0.5K <p>FY-3E/MERSI - validated against IASI – good results</p> <p>FY-3E/MWTS & MWHS – validated with ATMS</p> <p>Chengli also outlined CMA’s reprocessing campaigns for microwave sensors and IRAS, as well as GEO VIS channels and use of desert and snow PICS with monthly BRDF model</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>No time for discussion</p> <p>Offline:</p> <p>Q: Did you expect large degradation for FY-3A (>8%/year for 047 and ~5%/year for 065) channel?</p>	

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Did you see different pattern of degradation for 047 & 065 channels? Why? Did you expect large differences between HIRAS & IASI? Why?

Q: The MODIS BRDF product MCD43 is provided for some MODIS vnir bands and a few broad bands such as "visible" and so forth. The wavelengths is different from that of FY satellites. How do you apply the MCD43 to FY satellites?

Agenda Item: 2j ESA Agency Report

Presenter Philippe Goryl

Overview ESA plan to develop a GSICS portal & have updated calibration landing page. Philippe outlined the ESA contributions to the GRWG and GDWG sessions at this meeting and the recent microwave sub-group workshop.

Proposed several web meeting topics – GEO microwave, SLSTR calibration, Sentinel2A-2B inter-cal, SMOS and SWARM contribution to Space Weather

He reviewed numerous upcoming ESA missions, including 6 Copernicus expansion missions – all of potential interest to GSICS, in particular TRUTHS – to provide an SI-traceable reference for inter-calibration – now in Phase A/B1 - target launch 2030Q1. ESA now completing FDR for altimetry and atmospheric composition

- including Moon-calibrated SCIAMACHY data

ESA continue to monitor Sentinel-2 by vicarious calibration, followed by full reprocessing. Also for Sentinel-3 using 4 methods to update SLSTR cal coefficients. SLSTR lunar observations – now monthly acquisitions, to compare with LIME model

Discussion point, conclusions, Actions, Recommendations, Decisions

Comment: further Moon acquisitions from S-3 scheduled for 2022

Agenda item: 2k EUMETSAT Agency Report

Presenter Tim Hewison

Overview Tim updated on EUMETSAT plans to retire Meteosat-8 and launch the first of Meteosat Third Generation during 2022, and outlined EUMETSAT contributions to GSICS in 2021 and outlook for 2022.

Discussion point, conclusions, Actions, Recommendations, Decisions

No questions

Agenda Item: 2l NASA Agency Report

Presenter Jack Xiong

Overview Jack gave an update on NASA's contributions to GSICS, including MODIS and VIIRS calibration, calibration methodologies (including lunar) and supporting future

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	launches, including GOES-T, TROPICS, EMIT, SWOT, JPSS-2, ...
Discussion point, conclusions, Actions, Recommendations, Decisions	
Q: Plans for cubesat inter-calibration through GSICS?	
A: All have inter-calibration in their Cal/Val Plans – but not necessarily following GSICS	
Q: what's going to be the major improvement of MODIS new collection?	
A: Jack will send Jason Choi a paper or two for the details.	

NIST could not attend.

Agenda Item: 2m NOAA Agency Report	
Presenter	Fred Wu
Overview	<p>NOAA included a reduced report of State Of Observing Systems, focusing details for VIIRS and CrIS performance in 2021.</p> <p>S-NPP+NOAA-20/VIIRS DCC, WNO and PICS confirm no significant drift in VIS bands - operational calibration updated for N20</p> <p>N20/VIIRS RSB products from NASA v NOAA very stable & consistent within 0.2-0.4%</p> <p>SNPP/CrIS recalibrated 2021-07-13 after switching electronics sides – stability good</p> <p>ABI – IR calibration impacted (up to 0.1K) by raising detector temperatures – change in SRF?</p> <p>Research includes:</p> <ul style="list-style-type: none"> - new method to quantify thermal and 1/f noise in microwave sounders - New 32-day average difference method for monitoring radiometric biases <p>Reprocessing (Climate) - move from STAR to CLASS – for ATMS, CrIS & OMPS, VIIRS</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
Q: Where can the NOAA Microwave Satellite Data quality Monitoring System be found?	
A: I don't know, sorry. This is new to me as well. @Likun collected these information; perhaps he can tell you the source of information. Mark Liu and/or Ben Ho may also help.	
Q: ABI calibration change due to temperature change – most significant for non-window channels?	
A: Yes in terms of impact. SRF may change more for window channels without much impact.	
A: The quick answer is yes at some IR channels, especially at Ch13.3um. Fangfang is planning to give a talk on the G16/17 ABI IR cal/val at an IR web meeting sometime this year, most likely early this summer.	
Q: ABI updates VNIR bands calibration coefficients. Which calibration monitoring method is the calibration coefficients update based on? Referencing VIIRS, other approach, or best mix of some approaches?	

Agenda Item: 2n USGS Agency Report	
Presenter	Tom Stone
Overview	Landsat-9 launched 2021-09-27. Already operational within 4 months after numerous post-launch activities – including use of ground sites. L8-L9 comparisons

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	<p>good.</p> <p>OLI and OLI-2 includes two lamps and two solar diffusers + monthly Moon views.</p> <p>Agree well (within 1%) - except L8 working lamp and solar panels show degradations</p> <p>No straylight correction needed for L9 (unlike L8)</p> <p>Thermal infrared calibration monitoring highlights two events</p> <p>Landsat-7 still going, but equator crossing time drifting – plans to refuel in orbit!</p> <p>EROS Cal/Val Center of Excellence (ECCOE) includes lunar calibration WG</p> <ul style="list-style-type: none">- Planning to reprocess ROLO dataset and fit new irradiance model- Develop new techniques for Moon image processing from OLI <p>Satellite Cross-Calibration Radiometer (SCR) in development with Australia</p> <ul style="list-style-type: none">- Hyperspectral imager for cross-calibration – (not a SITSAT)
Discussion point, conclusions, Actions, Recommendations, Decisions	
Comment: Using Hugh’s new SLIMED model largely removed seasonal oscillations in OLI-2 trend	

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IR Break Out Session 16 March 2022	
Chair	Likun Wang
Minute Taker	Tim Hewison
Participants	<p>CNES: Yannick Kangah, Arthur Dick, Sebastien Marcq, Arthur Dick CMA: Yong Zhang, Ling Sun, Li Yuan, Chengli Qi, Scott (Xiuqing) Hu, Xingwei He, Song Guo, Lee Lu ESA: Fabrizio Niro, Silvia Scifoni, Stefano Casadio EUMETSAT: Tim Hewison, Dorothée Coppens, Bertrand Theodore, Sebastien Wagner, Viju John ISRO: Pradeep Thapliyal, Munn Vinayak JMA: Kozo Okamoto, Miaki Eiki, Kazuki Kodera, Kazutaka Yamada KMA: Hyelim Yoo, Jiyoung Kim, Eunkyoo Kim, Yooncheol Kim, Dohyeong Kim NOAA: Cheng-Zhi Zou, Conor Haney, Larry Flynn, Mark Liu, Fred Wu, Peter Beierle, Banghua Yan, Jason Choi, Denis Denis Tremblay</p> <p>UMD: Likun Wang, Fangfang Yu, Lin Lin,</p> <p>U. of Wisconsin: Dave Tobin NASA: Amit Angal, Conor Haney Uni Hamburg: Contanze Seibert, Martin Burgdorf</p> <p>Unknown: Shailesh Parihar, Su Jeong Lee</p>

Agenda Item: 3a Introduction, Agenda, and Plan

Presenter	Likun Wang
Overview	Likun introduced the agenda and proposed some further web meetings.
Discussion point, conclusions, Actions, Recommendations, Decisions	
Tim Hewison proposed a Web Meeting to discuss revisions to the GEO-LEO IR algorithm to give better performance for cold scenes, following his analysis of the impact of GSICS Corrections on SEVIRI L2 products. It was agreed that this should take place some	

Agenda Item: 3b IASI-A end-of-life tests

Presenter	Yannick Kangah for Laura LeBarbier (CNES)
Overview	<p>7 technical tests. Most relevant: NEdT improvement by switching off 3 out of 4 pixels - also reduced due to temperature decrease Inter-calibration with IASI-B and -C. Limb acquisition during backflip maneuver – although problems limited use of data after first 10 minutes</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: How to use overlap in spatial density-enhanced acquisitions? A: Could investigate applications requiring reduced noise Q: Idea to use increased overlap test to check geolocation accuracy. A: Expected same performance in terms of geolocation accuracy during test.</p>	

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Q: Was the temperature increase during the maneuver expected?
A: Not expected
Q: Did the limb acquisition start before the maneuver?
A: Yes
Q: Data availability?
A: Yes – through NOAA CLASS and EUMETSAT Data Centre from Campaign #3 (End of Life tests), but not Campaign #4 (deorbiting tests)

Agenda Item: 3c IASI SNO tests during Metop-A End Of Life

Presenter	Bertrand Theodore (EUMETSAT)
Overview	Limb acquisitions : Bertrand compared model and observations SNOs between IASI-A, -B (5 SNOs) and -C (3 SNOs): <ul style="list-style-type: none">- first time possible, as normal orbits out-of-phase- Average all pixels in orbit cross-over area- No cloud fraction available on scan edges (does this matter?)- Broke down by temperature class Availability of data from EUMETSAT – on request to ops@eumetsat.int
Discussion point, conclusions, Actions, Recommendations, Decisions	
Q: Have you compared with results of previous QSNO off-nadir comparisons?	
A: Not yet – but in the plan	

Agenda Item: 3d IASI nonlinearity correction

Presenter	Bertrand Theodore (EUMETSAT)
Overview	IASI non-linearity correction performed on-board in raw interferograms. Could it be removed a posteriori? Derived correction, based on earth view and black body interferogram baselines Initial validation confirms it works perfectly <ul style="list-style-type: none">- Now being tested over whole IASI lifetime
Discussion point, conclusions, Actions, Recommendations, Decisions	
Q: Congratulations! Even though they said it couldn't be done. How much processing work?	
A: about 1 month – before end 2022	
Propose to present at IR Web Meeting to consider whether GSICS proposes new dataset for IASI-A as anchor reference for FCDR generation.	

Agenda Item: 3e O-B comparison for GEO imager

Presenter	Su Jeong Lee (Ewha Woman's University, Korea)
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Overview	<p>From Lee and Ahn 2021, TGARS paper Applied to AMI, AHI, ABI, SEVIRI with ERA5 and KMA UM NWP + RTTOV RTM Clear sky over ocean for 1 month WV channels systematic bias due to NWP models being too moist Benefits:</p> <ul style="list-style-type: none"> - Able to capture stripes in CO2 channels (except SEVIRI) - Gives robust results with only 5 days data (as good as 1 month) - Multiple NWP models can reveal model biases - Can reveal RTM errors (e.g. O-A v SZA) - e.g. IR8 channel – due to Sea Surface emissivity – also used CRTM – to compare with RTTOV <p>Importance of having consistent cloud screen method for all satellites</p> <ul style="list-style-type: none"> - Stricter cloud screening gave better agreement with GSICS results
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: Any feedback on striping in CO2 channels from instrument scientists? Fred Wu: strong VZA dependence evident in O-A maps – warrants further investigation</p> <ul style="list-style-type: none"> - Related to striping - Could also check stripes correspond to instrument swaths - Mark Liu: VZA dependence coming from RTM <p>Q: RTM error at 8µm - due to RTM or model inputs? - Mark Liu offered to work together to resolve VZA dependence</p> <p>Q: For high VZA, do you use a ray-trace through atmosphere to include multiple grid points? A: no – could be a large effect for high VZA – could introduce systematic bias at high latitudes</p> <p>Q: gaps in Indian Ocean? A: Overlapped O-A from multiple instruments – could also use Meteosat-8/SEVIRI from 41.5°E in 2019</p>	

Agenda Item: 3f O-B all- sky comparison for Hiwamari-8 GEO Imager	
Presenter	Kozo Okamoto (JMA)
Overview	<p>First step to assimilation – investigate O-B characteristics NWP: JMA's GSM RTM: RTTOV + Joint-Simulator Obs: Himawari-8/AHI 1 month period (Aug 2018), with consistent cloud fraction Broke-down statistics between clear and all sky</p> <ul style="list-style-type: none"> - Found model dry bias and skin T bias, with strong diurnal var over land - Investigated contribution to biased pixels - Compared to distribution of AHI-IASI collocations' BT - – not enough to explain O-B biases - - some bias contributions found to be due to cloud model <p>Developed QC – remove scenes that cannot be well modelled (low BT, thick ice cloud, large O-B, large CA, ... Developed Bias Correction – based on Cloud Affect parameter (see Okamoto 2014 QJRMS) Compared O-B for AHI, ABI, SEVIRI (MSG4 outlier over S.Atlantic)</p>

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	<p>Expectation for GSICS Activity:</p> <ul style="list-style-type: none"> - Higher calibration accuracy – esp in low TB - Quantitative and detailed info on calibration error (scene dependence, scan dependence + diurnal changes) -
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: More info on DARDAR cloud model? A: Cloudsat+CALIPSO combined product, which reduced O-B bias</p> <p>Q: Any sign of striping in O-B images? A: Not found in ASR – but could be found in clear sky data, on close investigation</p> <p>Q: Is model input uniform within each swath? A: Use common profile – no 3D effects along slant-path – tricky in cloudy situations Comment from Su-Jeong: striping issue observed only in CO2 channels – and due to detector differences. Comment from Su-Jeong: striping issue observed only in CO2 channels – and due to detector differences.</p> <p>Q: Why striping/banding only found in CO2 channels? Web Meeting to follow-up on NWP method within GSICS Discussion for Friday plenary session: Cooperation with RTM developers to document</p>	

Agenda Item: 3g Performance Status of FY-3E/HIRAS and FY-4B/GIIRS

Presenter	Lu Lee (CMA)
Overview	<p>Lu introduced HIRAS-II and GIIRS, including the important new FY-3E early-morning orbit.</p> <ul style="list-style-type: none"> - HIRAS-II now 3x3 detectors, with 3 contiguous bands 650-2550cm-1 at 0.625cm-1 res. - LWIR and MWIR good noise performance - SWIR less so (esp FOV1) - Polar SNOs with IASI-B - BT diff <1K in MWIR & LWIR - Comparison with RTTOV similar - FY-4B/GIIRS - now suitable for NWP - Spectral calibration within ±7ppm - also checked with SNO with IASI-C

Discussion point, conclusions, Actions, Recommendations, Decisions

<p>Q: FY-4A also carries GIIRS - has this been used for any operational applications? A: Chengli confirmed some papers have been published by CMA NWP on case studies (e.g. wind forecasting and hurricane monitoring) A: Why change GIIRS focal plane detector layout? A: long story - originally planned as an imager-sounder - new layout reduces off-axis effect Q: What improvements in HIRAS-II design compared to HIRAS-I in instrument design? A: Detector layout now more similar to CrIS + better noise performance + contiguous spectra + processing at full spectral resolution</p>	
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Action: A.GIR.20220316.1: Chengli Qi (CMA) to share references of the papers mentioned on the impact of GIIRS on NWP (winds, regional,...) - Closed

- <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL093010>
- <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL093672>
- <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL093794>
- <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL096207>
- <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL095825>

Agenda Item: 3h Lake Titicaca as potential validation site	
Presenter	Denis Tremblay, Simon Hook
Overview	Lake at 3812m (649hPa) at 11-17°C Covers few CrIS FOV In-situ measurements of air temperature, pressure, RH, winds, skin temperature, radiosonde profiles + uplooking lidar and IR FTS + 4 buoys <ul style="list-style-type: none"> - Provide inputs into RTM to perform Obs-Calc Reviewed results for other lakes with MODIS+VIIRS <ul style="list-style-type: none"> - Works well for VZA<50°
Discussion point, conclusions, Actions, Recommendations, Decisions	
Q: What are the uncertainties in all the inputs? And how do you propagate them through the RTM? (see slide ~11) A: conducted experiment with tropospheric emission spectrometer over Lake Tahoe - comparing with modelled radiances within 0.3K - will share poster Comment: These are valuable dataset, but difficult working environment to collect on Tahoe Q: Ground-up estimate of uncertainty in modelled top of atmospheric radiances? A: Studies suggest 0.23-0.25K uncertainty from atmosphere + RTM - can share!	

Agenda Item: 3i The Moon as a tool for the calibration of infrared sensors	
Presenter	Constanze Seibert, Martin Burgdorf, Stefan Bühler (University of Hamburg)
Overview	Case of the moon in the HIRS FOV. Better seen in the LW channels, as in the SW the moon is moving inside the FOV. Methodology is explained to find the moon intrusion looking at the counts. The moon represents 0.5 degrees, in a 1.4 degree FOV. Preliminary results show the moon BT in dependance of the phase angle for SW. The moon BT is around 340 K. Good agreement was shown between different HIRS channels and validation with models as well.
Discussion point, conclusions, Actions, Recommendations, Decisions	
Q: With the movement of the moon and satellite and so on, how can you be sure the lowest count	

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gives the good position of the moon in the FOV?

A: For the LW it is constant and easy to use, SW is more difficult we can't be sure that we capture the moon

Q: About SEVIRI, there is saturation in the IR. We are not sure it is then possible.

A: Saturation is seen at specific phase angles. We need phase angle close to no moon (phase > 90) is possible, but not close to full moon where there will be saturation.

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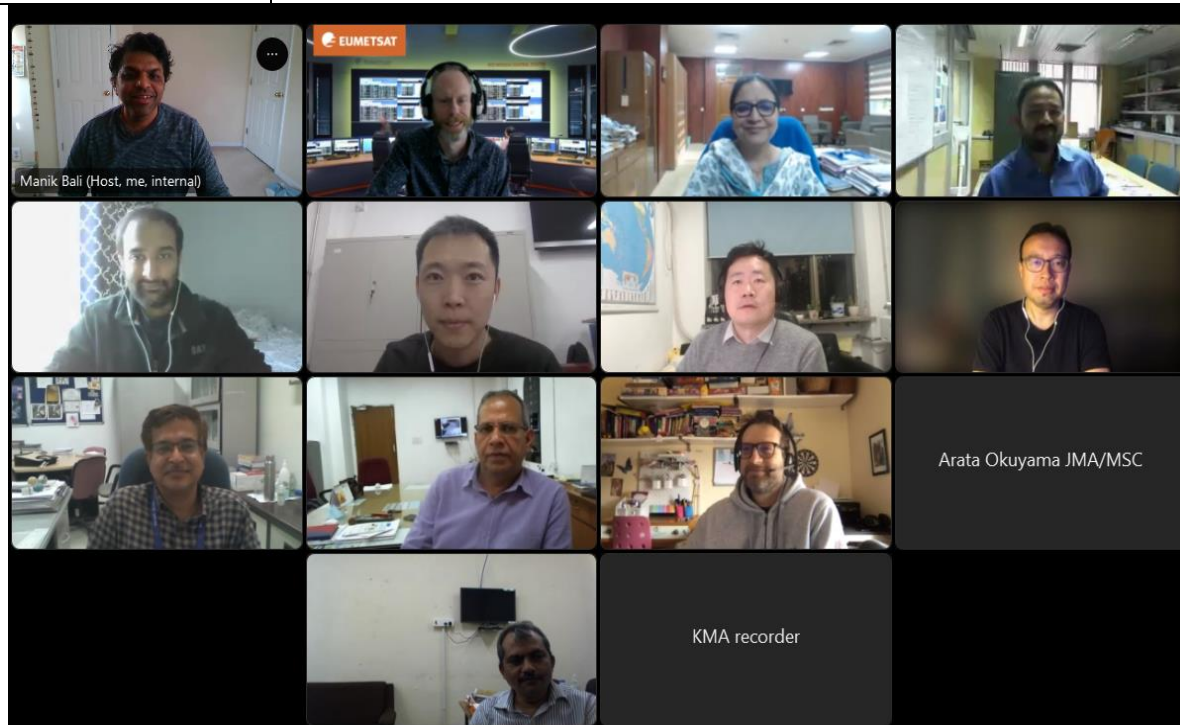
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GDWG Break Out Session 16 March 2022	
Chair	Kamaljit Ray
Minute Taker	Manik Bali
Participants	Tian Lin, Xian Di, Xu Zhe, A. K Mitra, Simon Elliot, Nitant Dube, Arata Okuyuma, Arun Ravindranathan, Paolo Castrane, Manik Bali, Rosario Ionnone, Ninghai Sun, SC Bhan



Group Photo: Top Left-Bottom Right: Manik Bali, Simon Elliot, Kamaljit Ray (Chair GDWG), Ashim Mitra(IMD), Lin Tian, Di Xian, Zhe Xu, Nitant Dubey(ISRO), S. C Bhan(IMD), Paolo Castracane(ESA), Arata Okuyama(JMA), R. K Giri (IMD), Eunkyuu Kim (KMA)

Agenda Item:	
Presenter	Kamaljit Ray/Manik Bali
Overview	Overview of GDWG activities
Discussion point, conclusions, Actions, Recommendations, Decisions	
Introduced GDWG and its membership Welcomed Eunkyuu Kim from KMA Provided updates on 2020 and 2021 actions. Provided overview of the GDWG activities from all agencies Main	
Agenda Item:	
Presenter	R. K Giri, IMD

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Overview	IMD GDWG Activities
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Visualization tool Data Supply Portal Rapid is a visualization tool for real time tools can be used for NWP data , satellite radar data and insitu observations https://rapid.imd.gov.in/r2v/ Data Supply System: Provision to access calibrated satellite images and data. Interactive user interface. Automatic extraction and supply of information. Satellite landing page is under development which would be done with ISRO New features would be added in the future to make it more user friendly. Q (Nitant). What is the relationship of RAPID with GSICS A. We are using GSICS calibrated data. Q(Nitant). The scope of RAPID is much beyond Satellite</p> <p>A.GDWG.20221603.1: IMD and ISRO to work on enhancing capabilities of RAPID to use visualize GSICS data</p>	

Agenda Item:	
Presenter	Arata Okuyuma
Overview	JMA GDWG Activities
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Provided GSICS Corrections by JMA. This includes H-8 RAC/NRT. JMA actively persuing transitioning from IASI-A to IASI-B/C and CrIS. JMA products daily bias can be seen on plotting tool at EUMETSAT JMA maintain GPRC pages and also maintains landing page and event logging. Implemented Raymatching approach and Event loggin. SRF of Himawari series available</p>	
Agenda Item:	
Presenter	Tian Lin, CMA
Overview	CMA GDWG Activities
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>CMA GDWG actively worked on RICH CEOS Program and supported retrospective processing. Tian provided details of each reprocessed dataset. These are VIRR and OLR spanning over 20 years. OLR data is daily mean data.</p> <p>R.GDWG.20220316.1: Agencies to share their reprocessing plans. A.GDWG.20220316.1: Discuss if reprocessed data be designated as a GSICS deliverable A.GDWG.20220316.2: GDWG members to inform GCC about the latest membership</p> <p>Q. Do you use GSICS coefficients in reprocessing. Or have you used more than GSICS coefficients A. This work was done by colleagues they can answer. A. This reprocessing is decided by IR subgroup. We can advice them to share information. They</p>	

GSICS WGs – 2022 Minutes

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are processing IR part however for Microwave reprocessing they are using other methods for adjustments.

A.GDWG.20220316.3: CMA to reveal use of GSICS coefficients in NWP processing

A.GDWG.20220316.7: GDWG to contact GRWG to gather requirements for combined product

Agenda Item:

Presenter	Nitant Dubey, ISRO
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Overview	ISRO GDWG Activities
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Provided an overview of ISRO GSICS Overview.

For the future Looking out to make ISRO THREDDs server merge with other thredds servers

Provided links to mosdac and gave the links to RAC and NRT coefficients

Q. Any progress in your collaboration with KMA

A. This year it would be initiated

Agenda Item:

Presenter	Paolo Castrane, ESA
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Overview	ESA GDWG Activities
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CEOS Cal/Val portal is the one stop shop for cal/val access to CEOS endorsed best practices.

Traceability in space. SITCOS Workshop.

Data from projects AXIX land Aqua and CMIX are available.

Would like to host notebooks for metrology analysis

EVDC is dataset dedicated to atmospheric validation data center.

MyEVDC space can provide feedback on EVDC. It has a orbit predictor tool

Q. What are the satellites your tools support are they only Copernicus

A. The tools are general and can cover non Copernicus satellites

Q Notebooks can you support GSICS notebooks

A. Discussion on this would be made.

There is a module that can help get collocation data set. Match up data base reports are provided.

ESA calibration landing page has been updated

Feedback on CEOS Cal/Val portal are welcome

A.GDWG.20220316.4: GSICS members to contact Paolo (ESA) and provide feedback to EVDC

A.GDWG.20220316.5: IMD/ISRO Cal/Val portal link to be provided to ESA to be included in the CEOS Cal/Val portal

A.GDWG.20220316.6: GSICS-GDWG(Manik) to work closely with ESA (Paolo) to integrate GSICS

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notebooks into the ESA metrology notebooks.

Agenda Item:

Presente | Manik Bali, NOAA

Overview | NOAA GDWG Activities

NOAA GDWG actively worked on

1. Maintaining and running
 - a. NOAA GSICS THREDDS server
 - b. GSICS Wiki server
 - c. GSICS Actions Tracker
 - d. GSICS Product Alert System
 - e. GSICS Product Catalog and Vizualization on Product Catalog
 - f. GSICS List Serv
2. NOAA GDWG also published new notebooks that can bring GSICS closer to its users. These include
 - a. Solar Analysis
 - b. GEMS Data Analysis (Restricted)
 - c. State of Observing System report generation

It also maintained notebooks created in the past year. These include

- A. Notebooks on Visualizing and Processing GSICS Products
- B. Notebook On Visualizing and Processing GSICS Deliverables

Into the future the NOAA-GDWG would focus on building new tools to deepen the GRWG collaborative environment.

<https://www.wekeo.eu/docs/using-jupyter>

Agenda Item:

Presenter | Discussion

Overview

Discussions on the following topics took place

1. SRF archival for UV/Vis spectrometer radiance degradation derived from 340 nm trends, fitting over all the detector rows to establish degradation coefficients
2. instruments

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- | |
|--|
| <ol style="list-style-type: none"> 3. Propose pro/cons of a combined product approach 4. Work on SRF writing s/w 5. ISRO IMD to work closely on plotting tool |
|--|

Next step a GDWG report was created and discussed in the cross-cutting session

10 March 2022

GRWG Breakout Session (UVN Spectrometer Sub-Group)	
Chair	Larry Flynn
Minute Taker	Alessandra Cacciari
Attendance	
Remote Attendance	Alessandra Cacciari, Alexander Marshak, Arata Okuyama, Berit Ahlers, Banghua Yan, Bob Potash, Colin Seftor, Chunhui Pan, Ding Liang, Glenn Jaross, David Haffner, David Flittner, Erwin Loots, Eric Beach, Fangfang Yu, Frank Ruethric, Irina Petropavlovskikh, Jianguo Niu, JeongAh Yu, Jingfeng Huang, Kai Yang, Kyung-Jung Moon, Larry Flynn, Manik Bali, Matthew DeLand, Marcel Dobber, Mina Kang, Minjin Eo, Mijeong Kim, Misaki Eiki, Nan Hao, Nikolay Krotkov, Natalya Kramarova, Odele Coddington, Ralph Snel, Sander Slijkhuis, Sebastian Gimeno Garcia, Steven Buckner, Gonzalo Gonzalez Abad, Thomas Kurosu, Omar Torres, Venkata Rao, Xiong Liu, Yeeun Lee, Yuan Li, Xiong Liu, Zachary Fasnacht, Zhihua Zhang

Agenda Item: Introduction	
Presenter	Larry Flynn
Discussion point, conclusions, Actions, Recommendations, Decisions	

Agenda Item: FY-3F/OMS pre-launch calibration and instrument performance	
Presenter	Yuan Li
Overview	<ul style="list-style-type: none"> development progress of O3 monitoring in CMA OMS Limb and OMS Nadir flight model test campaign in May 2022 scheduled for launch end of 2022
Discussion point, conclusions, Actions, Recommendations, Decisions	
Availability of measurements (post launch) and calibration data (prelaunch).	

Agenda Item: In-orbit performance and improvement of GEMS	
Presenter	Mina Kang
Overview	<ul style="list-style-type: none"> current status of GEMS - in flight SRF similar to pre-launch SRF -

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	<ul style="list-style-type: none"> GEMS irradiance spatial in-homogeneity and seasonal dependence (SZA). Correction procedure put in place, providing very good agreement with reference and other instruments Trend monitoring: current degradation of ~ 10% at 300nm
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Discussion on instrument throughput degradation and reference diffuser use in the estimate of the sensor degradation;</p> <p>OMPS/SNPP have been reprocessed, which can be also used here for comparison;</p> <p>GEMS data open release by the end of the year;</p>	

Agenda Item: TROPOMI L1b: toward collection 3	
Presenter	Erwin Loots
Overview	<ul style="list-style-type: none"> TROPOMI collection 3: targeted for 2022.07 transient pixel flagging improved with major revision and radiance drift correction. Current degradation ~14% UV ~10% UVIS irradiance degradation corrects for most of observed L2 degradation (ir)radiance degradation includes 1-year model extrapolation Reprocessing planned start by end 2022; until this is completed dataset available is "hybrid": uncorrected too low (ir)radiance (coll1) and uncorrected (too low) radiance (collection 2)
Discussion point, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> how to separate "common" radiance CKD and statistic pattern recognition wrt to the on-ground calibration CKD switch the roles of the diffusers as an idea to estimate degradation assumption, specifically, that both diffusers have similar degradation rates per exposure time. 	

Agenda Item: Updates on GOME-2. S4/UVN and S5/UVNS	
Presenter	Alessandra Cacciari
Overview	<ul style="list-style-type: none"> GOME2 /A/B L1 FDR (reprocessing) completed and validated. Upcoming official release. GOME2 operational spectral calibration update, and evaluation ongoing; S4 and S5 approach on <ul style="list-style-type: none"> In-orbit calibration / ground processor development status / Cal-Val Planning
Discussion point, conclusions, Actions, Recommendations, Decisions	
Availability of the reprocessed data-set via ftp?	

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Agenda Item: 10-Year Stability Performance of S-NPP OMPS Nadir Sensor	
Presenter	Chunhui Pan
Overview	OMPS 10-year stability - <ul style="list-style-type: none"> • routine bi-weekly solar calibration from 01/2016 • long term performance evaluation: weekly dark calibration and rate change • wavelength shift is maintained < 0.01 nm, evaluated through solar calibration • sensor degradation: time dependent correction for the throughput degradation is planned, needed for OMPS-NP shorter wavelengths • Evaluation of the degradation of working diffuser wrt to reference diffuser • reprocessed data- set for Lev1 available for SNPP and soon for NOAA20
Discussion point, conclusions, Actions, Recommendations, Decisions	
Geo-location issue: fixed in the reprocessing and for current operations.	

Agenda Item: Discussion topic on Comparisons of Solar Spectra	
Presenter	All, Larry Flynn, Mina Kang
Overview	Solar Irradiance and Earth Radiance very different approach in the community – Solar at 1 AU or Earth / Sun distance, Day 1 solar or with throughput degradation shared by radiances Comparison btw Solar Reference spectra - High resolution Solar Ref spectra compared to OMI and TROPOMI.
Discussion point, conclusions, Actions, Recommendations, Decisions	
R.GUV.20220310.1 : teams to provide Instrument Information Sheet on Solar and SRFs. Review the GSICS wiki for information already available A.GUV.20220310.1 : Larry to provide a template for the information sheet for the R.GUV.20220310.1	

Agenda Item: Update on a 10-channel spectroradiometer DSCOVER / EPIC	
Presenter	Alexander Marshak
Overview	<ul style="list-style-type: none"> • Filter Transmission function measured in vacuum before the launch • EPIC channel VIS and NIR channels calibrated compared with MODIS/MISR/VIRS; O2 bands using full moon views;

Discussion point, conclusions, Actions, Recommendations, Decisions

Agenda Item: TEMPO Calibration and Validation

Presenter	Xiong Liu & Dave Flittner
Overview	<ul style="list-style-type: none"> • L0- L1 processor V3 and validation plan • spatial res 2.0 x 4.75 km² • launch Dec 14 2022 • commissioning Phase ~ 90 days

Discussion point, conclusions, Actions, Recommendations, Decisions

Comments: concerning the GEMS Solar irradiance issue, something similar can be seen also by TEMPO. (BTDF: angles variation in inflight conditions is not in the on-ground calibration data)

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Agenda Item: OMI collection 4 calibration and instrument performance	
Presenter	Dave Haffner
Overview	<ul style="list-style-type: none"> • OMI collection 4 / LO-1b reprocessing (paper Kleipool et al, 2022 under review) • correction algorithms follow TROPOMI approach for most cases • Radiance degradation correction: <ul style="list-style-type: none"> ○ Radiance trends on the Antarctic Plateau • Radiance degradation derived from 340 nm trends, fitting performed over all detector rows to establish degradation coefficients.
Discussion point, conclusions, Actions, Recommendations, Decisions	
Comments on the OMI row anomaly, well documented and traceable in literature.	

Agenda Item: OMPS Comparisons	
Presenter	Larry Flynn
Overview	<ul style="list-style-type: none"> • Given the lack of time, this presentation will be one of four planned monthly meetings of the UVN Spectrometer Subgroup for the coming year.
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>R.GUV.20220310.2 : Hold a monthly meeting on Solar measurements and comparisons</p> <p>R.GUV.20220310.3 : Hold a joint monthly meeting with IR subgroup on OCO-n, GOSAT, CO2M, etc.</p> <p>R.GUV.20220310.4 : Hold a joint monthly meeting with the Vis/NIR subgroup on methods for calibration and comparison of reflective channels.</p> <p>R.GUV.20220310.5 : Hold monthly meeting with CEOS (WGCV and AC-VC) on calibration requirements and approaches for UV/Vis Spectrometer measurements for trace gas and aerosol retrievals.</p>	

Microwave Breakout Session 17 March 2022	
Chair	Co-chairs Qifeng LU (CMA) and Mark Liu (NOAA)
Minute Taker	Robbie Iacovazzi (GST@NOAA)
Attendance	26 Attendees: Rafaele Crapolicchio (ESA), Hu Yang (UMD), Ninghai Sun (NOAA), Xiaolong Dong (NSSC), Robbie Iacovazzi (GST@NOAA) Qifeng Lu (CMA), Quanhua Liu (NOAA), Banghua Yan (NOAA), Juyang Hu (CMA), Jian Shang (CMA), Karsten Fennig (DWD), Lin Lin (NOAA), Martin Burgdorf (Univ. Hamburg), Misako Kachi (JAXA), Neerja Sharma (ISRO), Nishima Singh (ISRO), Shengli Wu (CMA), Jun Zhou (UMD), Bomin Sun (NOAA), John Xun Yang (UMD), Manoj Kumar Mishra (ISRO), Pradeep Thapliyal (ISRO), Viju John (EUMETSAT), Yong Zhang (CMA), Heikki Pohjola (WMO), Tim Hewison (EUMETSAT)

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Agenda Item: Agree Agenda & Minute Taking	
Presenter	Co-chairs Qifeng LU (CMA) and Mark Liu (NOAA)
Overview	Welcome and Introduction into the Microwave Subgroup Meeting
Discussion point, conclusions, Actions, Recommendations, Decisions	
None	

Agenda Item: Toward the Consolidation of Standards and Metrics for Optimized Applications: Efforts for Microwave Sensors in CEOS WGCV	
Presenter	Xiaolong Dong, NSSC-CAS
Overview	CEOS WGCV Microwave Subgroup has actions related to microwave scatterometer and passive instruments. The scatterometer actions focus on instrument calibration and product validation, while the passive MW instrument actions are focused exclusively on instrument calibration. The MW instrument calibration work includes georeferencing, antenna pattern calibration, antenna temperature calibration. Passive MW instrument data validation methods include vicarious calibration with ocean and rain forest, cross calibration between instruments, and absolute calibration using simulated brightness temperature.
Discussion point, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> • Mark Liu – What is the difference between main focus with GSICS and CEOS? <ul style="list-style-type: none"> o Xiaolong Dong - GSICS objective to deliver data product related to intercalibration. Less focus on instrument calibration. • Hu Yang – GSICS seems to focus on weather satellite instruments, while CEOS seems to focus on active and passive microwave instruments. How do you perform do in-flight scatterometer inter-calibration? Is there a reference for this work? <ul style="list-style-type: none"> o Xiaolong Dong - Scatterometer instruments can have different sensor design and use different frequencies. We use the ocean surface and NWP as references. o Hu Yang – Should NWP be trusted as a reference? o Xiaolong Dong - Validation of ocean surface wind is accomplished with buoys. With the buoy data we can validate retrieval wind products from different satellites. • Mark Liu – Do you think you have ISO Standard definition of microwave sensor? <ul style="list-style-type: none"> o Xiaolong Dong - Definition for requirement for microwave standard for both imager and sounder. • Jun Zhou – How do you do on-orbit geometric calibration? <ul style="list-style-type: none"> o Xiaolong Dong - This is just processing to have geometric information. • Cheng-zhi Zou – Regarding your use of vicarious earth targets cal with targets. Where are the locations of your targets, and at what time scale is needed for stable comparison standard? <ul style="list-style-type: none"> o Xiaolong Dong - This specification is not the location of the target. Our CEOS working group defines the characteristics of the targets and the information we need. It does not concretely define where the targets are. It is related to method. • Raffaele Crapolicchio – I did not see uncertainty estimates for calibration activities for the radiometer. Do you have them? I think this is important. <ul style="list-style-type: none"> o Xiaolong Dong – I agree that they are important, but they are not defined here. 	

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<ul style="list-style-type: none"> o Raffaele Crapolicchio – Can you include the uncertainty of the procedures? o Xiaolong Dong – Yes, in the new series ... which is assessment of data. For the new series, the purpose is validation or assessment of the data product, not just retrieval.
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Agenda Item:) Performance of FY-3E MWTS-III and MWHS-II

Presenter	Juyang Hu - CMA
Overview	Discussed MWTS-III and MWHS-II validation activities related to the recent launch of FY-3E. The instruments are meeting design requirements. Compared with JPSS-1 ATMS, the standard deviations for most FY-3E MWTS-III and MWHS-II channels are less than 1K. For MWTS-III, higher biases for channels 15-17 and noise in channel 8 are on-going studies.

Discussion point, conclusions, Actions, Recommendations, Decisions

<ul style="list-style-type: none"> • Tiger – Do you think that the warm load temperature is affected by the sun in the early morning orbit? A blackbody temp of 320°C is high. It should be about the same as the receiver temp. Have you checked the warm load gradients using the PRTs? What is the difference between high and low PRT temperatures? <ul style="list-style-type: none"> o Juyang Hu – The PRT differences are very small. o Mark Liu – You need to check the MW sounder temperature calibration accuracy, because high temperature of blackbody could be problematic. Cal accuracy could be affected by difference in temp. o Banghua Yan – Is the graph showing the difference between instrument and blackbody temperature only for a short time period, or a longer time period? You talk about possible solar intrusion into the blackbody, can you speak more about this? o Juyang Hu – This is not what I mean. This could have to do with thermal transference of reflection from another instrument or the satellite, not sun getting directly into the blackbody. o Banghua Yan - AMSU-A could have large solar intrusion variation at short times that can cause 3-4 K error. Might want to check this. • Cheng-zhi Zou – What is the instrument ground resolution and the number of scan positions? <ul style="list-style-type: none"> o Juyang Hu - Ground resolutions are Channel 1 (75 km), Channel 2 (55 km), and Other channels (33 km). There are 98 scan positions per scan line.
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Agenda Item: FY-3E/WindRad in-orbit status and SNO preliminary results

Presenter	Jian Shang – CMA
Overview	The status of the FY-3E/WindRad instrument was shown to be quite stable, but high-energy particle event upsets have happened many times during the past several months. These events influenced some observational data. The Sigma0 of Ku band is larger than the C band, and both the C and Ku band data are expected to be improved. The external calibration will be carried out in the near future. Detailed simultaneous nadir overpass analysis with Metop SCAT, CFOSAT SCAT and HY-2 SCAT, as well as NWP ocean calibration, have begun and will be improved. The L2 wind vector products have been

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	successfully produced and accuracy is guaranteed.
Discussion point, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> • Unknown - Cross comparison – What is the difference between the incidence angle, because it has an impact on the backscatter coefficient? <ul style="list-style-type: none"> o Jian Shang - Influence is bigger than azimuth, and now we use 1 degree • Hu Yang– External calibration over land. Isn't there a problem with backscatter over land? This is for ocean application, so why don't you have an ocean site? <ul style="list-style-type: none"> o Jian Shang - The Mongolia active radar calibration site is used to perform active calibration for radar. These can be used to determine antenna response pattern. Data over the land and ocean will be calibrated with this site. If we use target over ocean, it will influence the observation of the ocean. We know the measurements of the calibrator • Hu Yang – You are operating in C and Ku band. Do you have a RFI issue for the active sensor? <ul style="list-style-type: none"> o Jian Shang - We have not thought about that. From several months of data, high energy particles are problematic. • Mark – You expressed a wind speed requirement. Do you have requirement for wind direction? <ul style="list-style-type: none"> o Jian Shang – About 20 degrees. 	

Agenda Item: NOAA Progress and Plans	
Presenter	Mark Liu – NOAA
Overview	<p>NOAA reports that several activities have made progress in the past year. The J2 ATMS calibration system is ready, and the NOAA Microwave Retrieval System (MiRS) for satellite products tested well with J2 proxy data. A new ATMS NEDT calculation algorithm has shown smaller variation compared to previous algorithms, and COSMIC-2 RO data was proved to help monitoring of ATMS O-B antenna temperature biases. Historical ATMS data reprocessing was completed and the data are publicly available through ftp and the NOAA CLASS website. NOAA has also generated over 40-year data records of FCDRs. New technology developments include the Hyperspectral Microwave Photonic Instrument (HyMPI), which shows great opportunities for improved microwave sounding. Also, the AI/ML technology is improving the accuracy of satellite product.</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> • Xiaolong Dong – For HyMPI, what is the assumed geometric resolution and NEDT when you evaluate the sensitivity of the modeled instrument, especially for the boundary layer? <ul style="list-style-type: none"> o Mark Liu - Spatial res is 5 km. o Robbie Iacovazzi - NEDT is about 2K less than 100 GHz, 1.5 K near 118 GHz and 1.0 K near 183 GHz. Bandwidth is narrow, so NEDT is larger than broadband microwave instruments. • Jun Zhou – Machine learning system to improve MiRS SST retrievals. You use the satellite data as the input, and the MiRS retrieval output as the truth to train your ML system? 	

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<ul style="list-style-type: none"> o Mark Liu – No, it is not this way. We perform the ML analysis two ways. In the first the satellite measurement of surface and surface input from buoy and ECMWF reference were used. The second does not use satellite measurement. It only uses MiRS retrieved product SST as input, which is based on satellite data. Together with zenith angle and MiRS liquid water as input, the ML performs with the best results.

Agenda Item: ESA Progress and Plans	
Presenter	Rafaele Crapolicchio – ESA
Overview	Discussed SMOS validation and follow-on project progress. It also discusses CIMR instrument progress. SMOS mission is in good operational status after more than 12 years in-orbit, and good agreement in brightness temperature with SMAP. The 3rd mission reprocessed L2 dataset has improved quality. ESA fosters SM and SSS validation activities throughout dedicated platform (PiMep-SSS, QA4SM). Fiducial Reference Measurements (FRM) for soil moisture activities have started. Continuous acquisition of L-band dataset over Dome-C for satellite validation since 2004. Several technology activities carried out towards a possible high-resolution SMOS follow-on mission (SMOS ops/FFLAS). ESA is very active in RFI monitoring and reporting. Next Copernicus CIMR mission status presented.
Discussion point, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> • Shengli Wu - Soil moisture reprocessing. Relationship has improved from 0.5 from 0.6, is this depending on ascending orbit or descending orbit? <ul style="list-style-type: none"> o Raffaele Crapolicchio - Ascending orbit improves the best, while descending improves, but a little bit less. We have an online validation report (https://earth.esa.int/eogateway/instruments/miras/quality-control-reports) • Shengli Wu - Dome-C comparison. The h-pol is less stable than v-pol? <ul style="list-style-type: none"> o Raffaele Crapolicchio - The variation in the surface – e.g., snow topology irregularities - can impact h-pol, and that is why it is not stable like the v-pol. 	

Agenda Item: MW Subgroup Workshop Summary and Actions	
Presenter	Robbie Iacovazzi (GST@NOAA) and Wu (CMA)
Overview	Covers the MW Subgroup Workshop Summary and Actions.
Discussion point, conclusions, Actions, Recommendations, Decisions	
<i>None</i>	

Agenda Item: MW Subgroup Planning, Actions, and Summary	
Presenter	Robbie Iacovazzi (GST@NOAA)
Overview	MW Subgroup planning for 2022
Discussion point, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> • Meetings 2022 <ul style="list-style-type: none"> o Web meeting months and subjects can be decided at another meeting. 	

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- o The decision to hold another three-day workshop (3 days) can be made at another meeting. (ACTION) Robbie can create a survey regarding the workshop and the interest in having another one.
- Collaborative Activities (Within MW Subgroup or with other groups)
 - o Lunar Calibration
 - Hu Yang – Could share
 - Lunar thermal model (disk average brightness temperature) for several microwave channels 23-183 GHz.
 - Publication/methods for geometric beam pointing accuracy check could be shared with the group.
 - If different satellite agencies can apply our suggested method to their lunar intrusion samples, we could share our research on microwave lunar calibration.
 - Martin Burgdorf
 - Performed beam pointing and calibration using the moon as well.
 - Make the results available and join in discussion with the GSICS VIS/NIR Lunar Cal Work Area.
 - Mark Liu – (ACTION – Martin Burgdorf and Hu Yang) Recommends just to share the data base associated with the lunar disc average brightness temperature for the microwave frequency range between 23 and 183 GHz.
 - o Deliverables
 - o MW Lunar Model - The database associated with the lunar disc average brightness temperature for the microwave frequency range between 23 and 183 GHz.
 - o GSICS Products
 - Viju John - EUMETSAT shares FCDR from a product navigator.
 - Robbie Iacovazzi - How do we help microwave data users that want to reprocess some microwave instrument data to some GSICS reference instrument?
 - Viju John - In some methods, the actual microwave instrument calibration is updated directly and biases are not generated. The FCDR themselves are the product. Can we make the FCDRs based on the microwave data GSICS Products?
 - What reference standards does the group support.
 - Are common FCDR methods used across GSICS?
 - o Technical Explorations
 - o SmallSat/CubeSat
 - Focus mainly on retrieved products, such as TEMPEST-D and TROPICS.
 - Hu Yang – Could use MICalPS or other calibration processing models to show the utility of the model, but we need the L0 data from these instruments
 - Mark Liu – NOAA has not made a commitment to obtain L0 data needed to perform calibration of these instruments using MICalPS or other calibration processing models. We have the L1b data.
 - Robbie Iacovazzi – Could the MICalPS model be sent for the SmallSat/CubeSat developers to use?
 - Mark Lui – It would first get permission from NOAA to send it.

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<ul style="list-style-type: none"> ▪ Tiger Yang – TROPICS has the capability of scanning the moon very often with its “sky-scan”, which is not available elsewhere. It would be useful to acquire these data. <ul style="list-style-type: none"> • Possible action - Obtain the lunar data acquire from TROPICS from MIT. ▪ Mark Liu – Recommend that we do inter-comparison studies with the SmallSat/CubeSat data, since we have the L1b data. <ul style="list-style-type: none"> • Possible Action - We could for example perform O-B analysis on the TROPICS data. ▪ Calibration comparison. Inter-comparison between SmallSat and environmental data products. • China - Data calibration evaluation on FY-3E. <ul style="list-style-type: none"> o NWP analysis based on the microwave sounder from this satellite would be very valuable since the early morning orbit is unique. It helps to resolve the impact of early morning orbit. <ul style="list-style-type: none"> ▪ Possible action – Obtain NWP results regarding the use of the MWTS-III from FY-3E. • Discussing the best use of the ATMS reprocessed data in ERA6 (2021-2026) (from 2021) <ul style="list-style-type: none"> o Mark Liu – Completed last year

VIS/NIR Break Out Session 17 March 2022	
Chair	David Doelling and Tom Stone
Minute Taker	Arun Gopalan + Sebastien Wagner/ Tim Hewison
Participants	CMA: Haifeng Qian, Ling Sun, Scott Hu, Yong Zhang, Yuan Li ESA: Berit Ahlers, Stefano Casadio, Fabrizio Niro, Philippe Goryl EUMETSAT: Sebastien Wagner, Tim Hewison, Ali Mousivand EWU: Yeeun Lee ISRO: Danish ?, K.N.Babu JMA: Kazutaka Yamada, Miaki Eiki, Arata Okuyama, Kazuki Kodera KMA: Hyelim Yoo, Jiyoung Kim, Eunkyuu, ... NASA: Dave Doelling, Amit Angal, Raj Bhatt, Myungje Choi, Arun Gopalan, Alexei Lyapustin, Robert Rosenberg, Ben Scarino, Jack Xiong NOAA/UMD: Fangfang Yu, Fred Wu, Larry Flynn, Sirish Uprety, Manik Bali, Bikash Basnet RAL: Dave Smith Rayference: Yves Govaerts USGS: Tom Stone, Hugh Kieffer (Celestial Reasonings) U.Col(?): Odele Coddington Hannah Bourne, Paolo Castracane, Prathana Khakurel, Rosario Quirino Iannone, Shailesh Parihar, Taeyoung Choi

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Agenda Item Presentation on the DCC Product Format

Presenter	Sebastien Wagner (EUMETSAT)
Overview	<p>Seb reviewed the format of the current GSICS VNIR products, which are based on DCC inter-calibration, but include the ability to represent a variety of methods – and a blend of their results.</p> <p>Issues:</p> <ul style="list-style-type: none"> - No plotting tool for current VNIR products - Could combine with IR tool, but complex – discussed since 2017... - Align product format with revised GEO-LEO IR - Have DCC is an intermediate product and combine the DCC and Lunar calibration when both are available

Discussion point, conclusions, Actions, Recommendations, Decisions

Dave: **Web Meeting** on DCC ATBD and intermediate product
 Need a GSICS Plenary discussion on product formats for IR, VIS/NIR, MW, ... **Web Meeting? 2023?**
 – volunteers to propose strawman?
 Larry Flynn: agreed
 Q: (Steve Goodman): Progress with plans for LI? Comparison with Lightning Mapper GLM+ FY4?
 (NOAA are planning a reprocessing campaign for GLM)
 A: (Dave): Not in VIS/NIR at the moment – need a coordinator (**Web Meeting on Lightning Imager inter-cal**)
 A: (Seb): EUM implementing DCC inter-calibration method on LI
 Comment: (Manik) GDWG can support

Agenda Item: Discussion of DCC Paper, VIS/NIR Priorities and Future Web Meeting Topics

Presenter	Dave Doelling (NASA)
Overview	<p>Discussion of VIS/NIR topics.</p> <p>GSICS recommendations: Migrate from Aqua-MODIS to N20-VIIRS as reference sensor. Utilize the TSIS-1 HSRS solar spectra.</p> <p>Get DCC method into a product, ATBD, paper, product format, tool display</p> <p>DCC SWIR product headed by Raj Bhatt</p> <p>Dedicated web meeting for ray-matching approaches</p> <p>Dedicated web meeting for PICS approaches</p> <p>Combining multiple independent calibration approaches</p> <p>Looking for volunteers to head these calibration efforts as well as sunglint, Rayleigh scattering, etc.</p>

Discussion point, conclusions, Actions, Recommendations, Decisions

Q: (Dave Smith): Monthly meetings good, but challenging to join all – can we advertise topics in advance?
 A: (Dave D): Will try to focus single issue for each meeting
 Larry provided a list of topical web meetings for UVNSG – see above.

Agenda Item: Suomi NPP VIIRS Calibration Comparison between NOAA and NASA Versions and

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Impacts on L1B products.	
Presenter	Sirish Uprety (NOAA)
Overview	<p>NOAA and NASA NPP VIIRS visible channel calibration agree to within 2.5% for all solar bands</p> <p>NOAA and NASA calibration agree to within 0.2% for SWIR bands</p> <p>The stability of both the VNIR and SWIR bands (derived using global DCC) are comparable between NASA and NOAA products (less than 1%)</p> <p>NOAA VIIRS calibration requirements were to be within 2%. NOAA NPP VIIRS V2 were within 2% of intercomparison with RVUS Radcalnet, Landsat-8 OLI, and AQUA MODIS</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Q: Dave Smith: Should he use NPP-VIIRS NASA or NOAA Calibration Reference for his work?</p> <p>A (Dave Doelling): NOAA-20 Cal is very consistent between NOAA and NASA. No end-user recommendations made. Uprety concur's with Doelling positions. Not purpose of discussion to say which is better – but indicates magnitude of differences from different calibration approach – even max 2.5% difference within 3% expectations.</p> <p>Q: Can you confirm there is no difference due to solar spectrum?</p> <p>A: Yes – that is accounted for</p> <p>Q: trend in M3 and M4 – different between NASA and NOAA ?</p> <p>A: could be due to nonlinearity, introducing different trends over desert and DCCs</p> <p>Q: was solar diffuser fully abandoned for some bands (M5, M7, I2), but not M6?</p> <p>A: M6 used for ocean color – saturates over desert and DCC</p>	

Agenda Item: MODIS and VIIRS stability based on Libya-4 using the MAIAC framework	
Presenter	Alexei Lyapustin (NASA)
Overview	<p>SNPP, J1 VIIRS Calibration Analysis over Libya-4 site</p> <p>Presented the MAIAC reflectance observed over the Libya-4 site.</p> <p>The stability of SNPP VIIRS visible channels were with in 0.1%/year</p> <p>The stability of N20 VIIRS visible channels were within –0.5%/year (be aware this is a short time series)</p> <p>Cross-calibration over Libya-4 was using DESIS hyper-spectral reflectances</p> <p>The Aqua-MODIS/NPP-VIIRS and Aqua-MODIS/N20-VIIRS inter-calibration ratios were mostly consistent with results from Jack Xiong's group</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
Doelling: Libya4 can be used for both Stability and X-Calibration. No other questions.	

Agenda Item: GSICS DCC ATBD	
Presenter	Raj Bhatt (NASA)
Overview	<p>The newly revised GSICS DCC Calibration ATBD for GEO imagers: Community feedback and Discussion</p> <p>Reviewed the ATBD and discussed questions brought up by JMA, EUMETSAT and NOAA</p> <p>When using deseasonalization make sure to have complete years before computing</p>

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	<p>trend.</p> <p>The NOAA and NASA N20 VIIRS L1B visible calibration differences are less than 0.2% Need to have the same temperature threshold between VIIRS and GEO, this requires inter-calibrating VIIRS 11µm channel with GEO. Utilizing the GSICS IASI inter-calibration with both VIIRS and GEO is needed and then utilized for both, NASA has not applied the GSICS IASI. The goal is to make sure that the 205K GEO and LEO BT are the same. NOAA brought up about VIS and IR pixels size for both GEO and LEO. This needs to be looked into. Because spatial homogeneity filters are applied this may reduce the impact of pixel size differences. JMA asked if coincident VIIRS and GEO DCC is needed. No because this is an invariant target method. Visible bin size is a balance between noisy PDF and calibration sensitivity</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
No time for discussion	

Agenda Item: Harmonization of PICS and Moon Calibration Methods	
Presenter	Yves Govaerts (Rayference)
Overview	<p>Role of correlated uncertainties in vicarious calibration reference harmonisation Yves set up the problem using covariance matrices and error distribution of the uncertainty parameters. Concluded that Monte Carlo Method (MCM) assumes a near Gaussian distribution and recommended for the first sensitivity analysis. Spectral covariance uncertainty affects adjacent spectral bands; Need to be applied to all variables with correlation in all dimensions (spectral, temporal and spatial/targets), but only with MCM. Impact of RTM uncertainties still needs to be accounted for</p>
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Very interesting talk - it is particularly relevant for defining uncertainty estimates for Desert targets which I don't think it has been done properly in the past - usually standard deviations. Are the uncertainties for a specific scene reflectance? How do you propagate to different radiance levels? Dave - 1) we looked at different CEOS desert sites in Lyapustin et al., AMT 2014, and found that few of them have a long-term variability and cannot be considered quasi-stable. 2) Yes, the results are specific for Libya4, ~5x5km2 area (that's where we have the DESIS); 3) We assume linearity (after MCST/VCST calibration), so it's essentially one medium brightness point. Yves Govaerts: -> Correlated Uncertainties. Formally defined Harmonised. Characterize the Reference (Space/Time/Spectral) Tom Stone: Concurs with Dave Smith comments. [10:03 AM] Lyapustin, Alexei I. (GSFC-6130) Yves - how did you compute the uncertainties in rho, k etc.? Tom Stone -> Have discussion in sub-group meeting.</p>	

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Agenda Item:	
Presenter	Dave Smith
Overview	SLSTR A& B Lunar Calibration Status
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Tom Stone Comment: Comparison against LIME, differences will be found (against GIRO)</p> <p>Vance Haemmerle: Polarization Corrections?</p> <p>Seb W: Interested in Comparisons between LIME and GIRO. Co-registration progress and Normalization progress. ?</p> <p>Smith: Negative . Off-Nadir data has raised some geometry issues.</p> <p>Stone: Account for sampling in both directions. Smith: Pointing is not all figured out.</p> <p>TaeYoung Choi:- Question about phase angle and applicability of GIRO for that phase value</p>	

Agenda Item	
Presenter	Tom Stone
Overview	Discussion on Lunar Calibration Comparisons Between Instruments
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Open discussion about reasons for dispersion in comparisons between SLIMED and several instruments lunar measurements, as presented by Hugh Kieffer to Vis/NIR subgroup monthly meeting on 10 February 2022. Topics to consider/discuss: irradiance measurements from images, acquiring Moon observations with close to operational configuration, need for accurate reference irradiance measurements.</p> <p>Hugh Comment: Alert to look very carefully at size of source effect (weak but extended when looking at Moon).</p> <p>Tom Stone: Clipping of SLSTR images. Smith: Need to be careful in interpreting images. Artifact of image processing is in there</p> <p>Hugh: Possibilities to drive down scaling uncertainties. How much unique Solid Angle on Moon is represented by each pixel. Different approach: take all pixels and put them fixed solid angle space and derive size of moon image.</p> <p>Tom: recommend Hugh to present this approach at a future VisNIR subgroup meeting.</p> <p>Vance Haemmerle (Guest) Is it not the amount of unique part vs amount of repeated part?</p> <p>Hugh: Correct representation for getting from Radiance to Irradiance.</p> <p>ARCStone Timeline discussion. integrate into launch vehicle in 2 years. Activity to collaborate on estimation of Lunar Irradiance?</p> <p>Vance Haemmerle (Guest) For imaging systems where the spatial response function is much larger than a pixel size, the resulting moon map would be the actual size convolved with the SPF, no?</p> <p>Stone/Hugh: Some instruments cluster around SLIMED line in figure. Vicarious Calibration Methods do</p>	

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not have this larger spread. Truth is somewhere in that cluster?

Manik Bali: is there a plan to share lunar images taken by different instruments?

ROLO and GIRO are different from LIME.

Hugh: Polarization issues could explain some of the spread wrt instruments.

Manik: The next GSICS Quarterly will include an article on SLIMED.

Agenda Item	
Presenter	Seb Wagner
Overview	Lunar discussion
Discussion point, conclusions, Actions, Recommendations, Decisions	
Lunar Calibration Activities in EUMETSAT. Propose the next lunar calibration workshop for Q3/Q4 2023, hosted at EUMETSAT. List of topics to cover at the workshop	
Discussion: Establishing the observables is key. Resuming lunar model intercomparison exercise is needed. Work in IR and MW.	
Jack Xiong: Q4 is better for workshop. Hybrid meetings are more likely in the future given various constraints. Preliminary work to focus on progress.	
Hugh: distribute questionnaire on how people do Lunar Calibration?	
Discussion on VIS/NIR sub-group meetings. Hugh: Lot of instruments needed to cover Libration Space.	

Plenary Cross Cutting GRWG+GDWG 18 March 2022	
Chair	Larry Flynn
Minute Taker	Manik Bali
Attendance	
Remote Attendance	Arata Okuyama, Arun Ravindranatham, Bomin Sun, Conor Haney, Cheng-Zhi Zou, Denis Trembley, Dave Doelling, Heifing Qian, Heilum Yu, EunKyu Kim, Fabio Niro, Fred Wu, Fabrizio Niro, FangFang Yu, Gabriele Brizzi, Jun Zhou, Jack Xiong, Kazuki Kodera, Kazutaka Yamada, Heikki Pohjola, Hyelim Yoo, Jiyoung Kim, Kamaljit Ray, Larry Flynn, Lin Lin, Likun Wang, Manik Bali, Raj Bhatt, Sebastien Wagner, Shaliesh Parihar, Scott hu, Shengli Wu, Sun Ling, Sirish Uprety, Tian Lin, Tim Hewison, Misaki Eiki, Martin Bergdorf, Mark Liu, Misako Kachi, Robbie Iacovazzi, Paolo Castracane, Pradeep Thapliyal, Philippe Goryl, Taeyong Choi, Tom Stone, Silvia Scifoni, R. K Giri, Viju John

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Agenda Item:	
Presenter	Larry Flynn
Overview	Introduction and GCC Report
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>The GCC Director shared with the community the activities that GCC took in the past year to support GSICS community. He reported that the GSICS community has maintained its growth path with increases in membership of list serv and other GSICS platforms.</p> <p>The GCC took the following activities in the past year</p> <ol style="list-style-type: none"> 1. Published Four Newsletters with two special issues on State of Observing System 2. Maintained the GSICS Product Catalog 3. Maintained the GSICS Wiki server 4. Built tools to help members participate in GSICS activities 5. Supported virtual meetings (Annual, EP and web) 6. Built outreach to NWP, ISCCP and Australian Calibration/Space Community <p>Going forward the GCC work closely with the GRWG GDWG and our friends in WMO entities to support collaboration.</p> <p>A.GCC.20220318.1: GCC to edit an article on Notebooks, wiki and pages GSICS Tools</p>	

Agenda Item: GRWG Report	
Presenter	Fangfang Yu
Overview	
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Fangfang Yu presented the GRWG summary report. She mentioned that following the meeting we have the possibility of adding new deliverables. Requested members to nominate Vice Chair for GRWG.</p> <p>It was discussed if the State of Observing System Report should it be a deliverable.</p> <p>GRWG Continued to reach out to NWP/RTM, ISCCP-NS and extend the influence of calibration activities in commercial space.</p> <p>She pointed out the advances in GSICS, implementation of harmonized products. Gave an overview of topics discussed in Mini conf and suggested topics for web meetings</p> <p>Larry: On space weather we had exchanges with WMO and Elsayed and Tsutomu, and we had directions from EP of organizing a session at the annual or the GSICS EP meeting. ESA is interested in Space Weather. Most likely CGMS would provide further guidance on SW to us</p> <p>Tim: Two things we can discuss 1) Chairing GRWG did we have any offers of interest 2) Larry: We don't have a vice chair. We allow self-nomination. Fred: How do we proceed? Weather we should wait for a volunteer to Chair?</p>	

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Tim: If there is no volunteer, we should raise it to EP.
 Scott: Suggest next chair from EU since Fangfang was from US and I from Asia

Heikki: On SW it would be raised on CGMS. WMO expert on SW would be heading it.

D.GWG.20220318.2: GSICS SOS to be designated as a recurring deliverable and named GSOS.

Fred Wu: We have to document the difference between Correction Vs Harmonization Vs Homogenization

Agenda Item GSICS IR Subgroup Report	
Presenter	Likun Wang
Overview	
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Several instruments covered in the breakout session. Past year we had four web meetings in the IR subgroup</p> <p>This year we had total 7 presentations out of 11 presentations received. Rest will be covered in monthly meetings.</p> <p>Among the highlights are in-situ measurements during field campaigns, RTM and moon as a potentially serve as tool to inter-calibrate IR sensors.</p> <p>We also discussed the potential impact of IASI-A End of life on products.</p> <p>And discussed the transition from SNPP to NOAA20/CrIS</p> <p>Likun provided a summary of Product Status</p> <p>Likun requested a new person to chair IR.</p> <p>Upcoming and future plan is to enhance collaboration through GitHub and other platforms.</p>	

Agenda Item: GVISNIR	
Presenter	Dave Doelling
Overview	
Discussion point, conclusions, Actions, Recommendations, Decisions	
<p>Recommend to migrate from Aqua Modis to N20-VIIRS as N20-VIIRS is the GSICS reference.</p> <p>SNPP- N20 VIIRS differences have been quantified and revealed via articles in the newsletter and presentations in the breakout session by Sirish Uprety.</p> <p>VISNIR subgroup also recommends to utilize TSIS-1 HSRS reference Solar Spectra</p> <p>Tom: Move to TSIS-1 HSRS Solar Spectrum as it is the best available.</p> <p>Fred: We can try to use this Solar for GOES if we get good references.</p> <p>Fred: If we use TSIS as Day 1 solar it would be a strong case.</p> <p>R.GWG.20220318.4: GSICS Recommendation use of TSIS-1 Solar spectrum</p>	

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Coordinating with CLARREO:

CLARREO first year of operation with be dedicated to intercalibration NOAA-20 VIIRS and CERES.

Other members also showed interest in doing so.

VIS/NIR goals: Develop ATBS for DCC and future GSICS products

Dave mentioned that VISNIR organized eight monthly web meetings in the past year and future web meetings are planned in the coming year.

It was discussed if we could consider an action on the GRWG chair to coordinate the writing of a best practice with a recommended spectrum, which could be endorsed by the GSICS exec panel?

Sebastien: It would fit one of the purposes of GSICS goals to come up with best practices (white papers) and recommendations. What is the best practice of designating an entity as a GSICS Recommendation

Larry: It might not be a GSICS deliverable

Tom: Write a white paper that puts down in writing GSICS recommendation on solar spectrum

Manik: Typically acceptance processes in GSICS are QA4EO stamped. So if we are to apply a recommendation on a data set then this recommendation process has to be vetted by QA4EO for EP to accept its application on the TSIS.

A.GVNIR.20220318.6: GRWG (Dave) to work with GCC lead a recommendation to EP of recommending TSIS-1 HSRS as a reference Solar spectrum

Tom Lunar:

VisNIR breakout lunar session started with Dave's talk and moved to a discussion. How moon images are processed lunar irradiance images.

ARCSTONE project is a CubeSat project.

Potential action to revive lunar model inter-comparison exercise and report results at 2023 annual meeting.

It is proposed that the next GSICS Lunar Calibration workshop to be hosted by EUMETSAT in Nov-Dec 2023 time frame.

Agenda Item: GMW Report

Presenter	Quanhua (Mark) Liu
Overview	
Discussion point, conclusions, Actions, Recommendations, Decisions	
Presented Overview of Microwave subgroup meetings. Provided topics discussed in the breakout session.	
This included Improvements in MW calibration and geolocation approach. Instrument	

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performance monitoring and uncertainty characterization. Harnessing COSMIC GNSS. And new algorithm to determine MW sensor NEDT.T.

Marc provided highlights of instrument performance of CMA where they compared with JPSS satellites. JAXA MW instruments worked within specs. Interference from 5G satellites has been mitigated. Added G band.

MW Sounder conference was very successful. Reprocessing of ATMS was completed.

New hyperspectral MW satellites are being planned such as NASA HyMPI. Subgroup had wide ranging discussions. In conclusion provided overview of actions.

Marc finally provided plans for the future that included providing more deliverables and developing GSICS products

Tim: Group should Develop intercalibration product for NRT application

A.GMW.20220318.8: Action: Mark to identify who would follow-up on successor of Wes Berg on GPM XCAL algorithms

Robbie: We would like to have FCDR considered as products.

Larry: This is a wide topic. It is a discussion we should have with GRWG weather we should have such products.

Agenda Item: GUVNS

Presenter	Larry Flynn
Overview	

Discussion point, conclusions, Actions, Recommendations, Decisions

The breakout session had a good representation. Instruments such as GEMS, TOPOMI, FY-3F/OMS, SNPP/OMPS, and Epic/DSCOVER were discussed.

Planned to have a joint meeting with IR VIS/NIR and to hold a monthly meeting with CEOS WGCV ACSG and AC/VC

Larry provided an overview of an Instrument Team information sheet.

We should have SRF archived and generate synthetic irradiance data. Action has been placed with GDWG on this.

Agenda Item: GDWG Report

Presenter	Manik Bali/Kamaljit Ray
Overview	

Discussion point, conclusions, Actions, Recommendations, Decisions

Kamaljit Ray/Manik Bali reported on discussions in the GDWG Breakout session.

Provided

1. New member Eikyu Kim welcomed to GDWG
2. CMA: Provided updates to their Reprocessing Project (RICH)
3. JMA: Landing pages updated and maintained the GPRC. They are migrating to IASI-B/C and CrIS

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4. NOAA: New Notebooks and maintained services such as GSICS Wiki, Action Tracker, Product Catalog and Alert System
5. ISRO: Plotting tool that can plot GSICS products and revealed anomalies in instruments
6. IMD: Plotting tool called RAPID. Can have the ability to plot GSICS products. Discussions with ISRO and GSICS community to forward.
7. ESA: Shared interest in Notebook development. ESA made tremendous progress in building CAL/VAL portal for use by CEOS community and beyond.

Going forward the following Actions are being discussed.

R.GDWG.20220316.1: Agencies to share their reprocessing best practices

A.GDWG.20220316.1: GDWG to discuss if reprocessed data be designated as a GSICS deliverable

R.GDWG.20220316.2: GDWG members to inform GCC about the latest membership

A.GDWG.20220316.3: CMA to present use of GSICS coefficients in NWP processing

A.GDWG.20220316.4: GSICS members to contact Paolo (ESA) and provide feedback to EVDC

A.GDWG.20220316.5: IMD/ISRO Cal/Val portal link to be provided to ESA to be included in the CEOS Cal/Val portal

A.GDWG.20220316.6: GSICS-GDWG(Manik) to work closely with ESA (Paolo) to integrate GSICS notebooks into the ESA metrology notebooks.

A.GDWG.20220316.7: GDWG to contact GRWG to gather requirements for combined product

A.GDWG.20220316.7: Provide guidelines for UV SRF and help with readers and writers

A.20210331.1 To have a meeting on building the best practices for plotting tool. ISRO and CMA, KMA on plotting tool

A.20210331.2.: ESA to explore providing link of product catalog on EVDC and other ESA websites

Agenda Item: Web Meetings for 2022/3

Presenter

All

Overview

List of web meetings identified during 2022 annual meeting

Discussion point, conclusions, Actions, Recommendations, Decisions

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Plenary:

- Need a GSICS Plenary discussion on product formats for IR, VIS/NIR, MW, - in 2023 meeting, following definition of final + intermediate product contents in VIS/NIR + IR Sub-groups – user preferences?

GRWG:

- **Web Meeting to follow-up on NWP method within GSICS - monitoring/correction**

IR:

- Likun introduced the agenda and proposed some further web meetings.
- Bertrand Theodore (EUMETSAT) at IR Web Meeting to consider whether GSICS proposes new dataset for IASI-A as anchor reference for FCDR generation.
- Revisions to the GEO-LEO IR algorithm to give better performance for cold scenes, following his analysis of the impact of GSICS Corrections on SEVIRI L2 products.
- Web Meeting: follow-up on INSAT-3R bias during eclipse season
- Web Meeting: on IASI Lunar Calibration
- Propose discussion on SRF retrievals for web meeting - including Xu Na
- SLSTR calibration (ESA+EUM)

VNIR:

- White paper on recommended solar spectrum (TSIS-1)
- DCC ATBD and intermediate product
- Seasonal cycle in ABI/AMI VNIR calibration
- Web Meeting on Lightning Imager inter-cal
- Sentinel-2A/2B inter-calibration
- SLSTR calibration in VIS/SWIR complementing the existing PICS analysis with results from a currently ongoing 'mini'-round-robin between CNES and RAL
- Ray-matching: incl. Radiance biases based on ray-matching for sensors onboard GK-2 series inter-comparison results (shorter than 500 nm) of AMI, GEMS and GOCI-2 onboard GK-2A and B + Validation results for AHI by ray-matching method with VIIRSs
- Lunar Calibration: Evaluating Radiometry within a Heterogenous Satellite Fleet via Continuous Moon Monitoring
- Lunar Calibration: pixel spatial evaluation concept (Hugh Kieffer)
- Lunar Calibration: OLCI + SLSTR lunar observations
- Performance of FY-3E MERSI_LL onboard calibrator for the reflective solar bands
- In-orbit Radiometric calibration progress of Fengyun-4B GHI
- Ocean Color & Land applications: incl. result of the second intercomparison exercise of atmospheric correction ACIX-II + potential feature in 2023 meeting, Libya-4 atm. correction (incl PICSAR) – to invite WGCV (ESA to coordinate)

UVNS:

- UVNS to hold monthly web meeting in collaboration with VIS/NIR

MWSG:

- GEO microwave (ESA)
- Lunar microwave

Space Weather

- SMOS and SWARM contribution to Space Weather
-

Decision: Revised plan for monthly web meeting Thursdays:

1. IR
2. VIS/NIR
3. Microwave
4. UVNS
5. GDWG

GSICS WGs – 2022 Minutes

Action: in red, Recommendation: in green, Decision: in blue

Format of Action/Recommendation: [A,R].GsicId.yyyy.agendaItemId.actionCount

Valid GsicId : [GDWG | GRWG | GCC | GWG | GIR | GVNIR | GMW | GUV]

agendaItemId: agenda item ID (Example: A.GWG.2022.3o.1 – GRWG & GDWG action 1 at agenda#3o)

AOB:

- Benefit of extending the lifetime of operational microwave sounders – how to encourage agencies to keep them alive?

Recommendation: Exec Panel to encourage satellite agencies to keep microwave sounders operational for as long as possible to extend over-lap period for inter-calibration and FCDR generation (in addition to benefit to NWP)

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Speaker's list - 2022 GRWG/GDWG Annual Meeting

Mitch Goldberg	Larry Flynn	Manik Bali
Fangfang Yu	Kamaljit Ray	Tim Hewison
Roger Sonders	Leonhard Scheck	Mina Kang
Quanhua Marc	Robbie Iacovazzi	Yuan Li
Xiuqing Hu	Ling Sun	Hannah Bourne
Viju John	Xiangqian Wu	Andrew Heidinger
Dave Haffner	Xiong Lu	Dave Flittner
Chunhui Pan	Alessandra Cacciari	Erwin Loots
Arat Okuma	Jiyoung Kim	Clemence Pierangelo
Ashim Mitra	Heikki Pohjola	Chengli Qi
Philippe Gorly	Jack Xiong	Tom Stone
Likun Wang	Bertran Theodore	Su Jeong Lee
Kozo Okamoto	Lu Lee	Denis Tremblay
Simon Hook	Constanz Seibert	Martin Bergdorf
Stefan Buhler	R. K Giri	Tian Lin
Nitant Dube	Paolo Castracane	Sebastien Wagner
David Doelling	Sirish Uprety	Alexei Lyapustin
Raj Bhatt	Yves Govaerts	Dave Smith
Tom Stone	Xiaolong Dong	Juyang Hu
Jian Shang	Mark Liu	Raffaele Crapolicchio
Pradeep Thapliyal		