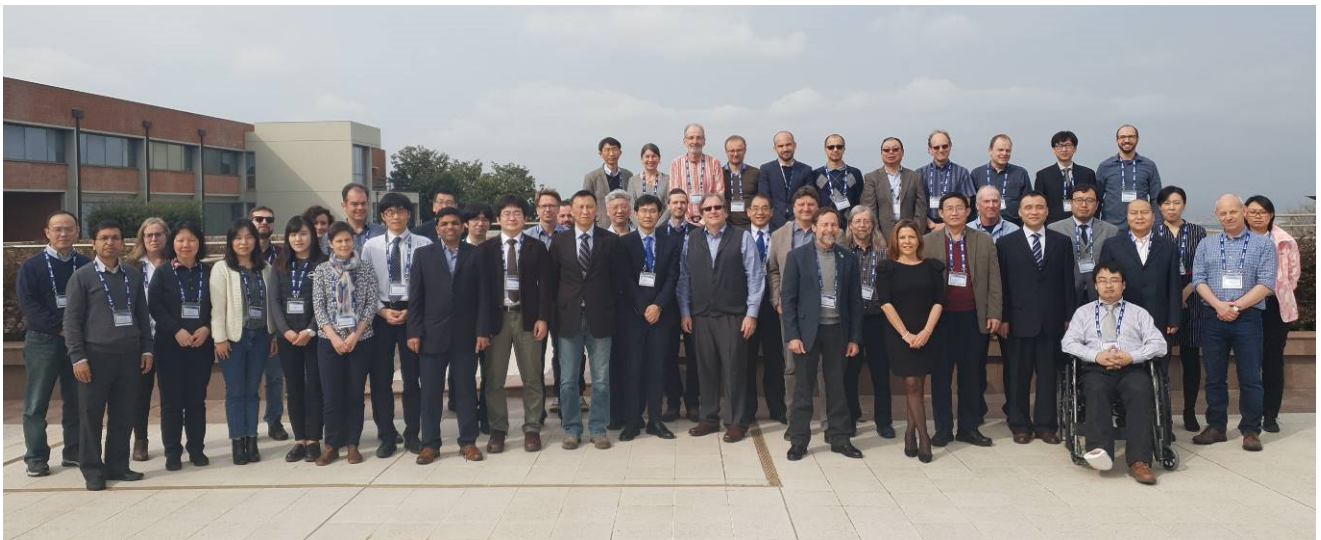




Minutes of the 2019 Annual GSICS Joint Working Groups Meeting 4 – 8 March 2019, Frascati, Italy



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

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

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

agendaItemId: agenda item ID (Example: A.GWG.2019.3o.1 – GRWG & GDWG action 1 at agenda#3o)

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Plenary Mini Conference – AM on 4th March, 2019

Chair	Philippe Goryl (ESA)
Minute Taker	Fabrizio Niro (ESA)
Attendance	Lots - see attendance register

Agenda Item: Opening Remarks – 8:25 (5 minutes)

Presenter	Mitch Goldberg (NOAA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
Mitch welcomed the participants of the meeting and welcomed ESA as a full member of GSICS along with ROSCOSMOS and SITP as new members.	

Agenda Item: 1a Welcome address– 8:30 (5 minutes)

Presenter	Philippe Goryl and Nicolaus Hanowski (ESA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
Nicolaus welcomed the meeting participants and introduced the activities of ESA-ESRIN, who now manage the operations of seven Sentinel and seven Earth Explorer satellites. The principles and guidelines prototyped within GSICS, i.e. to have <i>system of systems</i> of inter-operable sensors are really valuable for ESA, as a way to make the best use of the number of sensors currently flying as part of the ESA EO programme.	

Agenda Item: 1b Introduction to Mini Conference & GSICS – 8:35 (15 minutes)

Presenter	Xiuqing (Scott) Hu (CMA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
Scott provided an overview of GSICS activities and deliverables, and introduced the "Mini Conference". XH provides an overview of GSICS foundation principles and motivations. The objective is to improve inter-sensor consistency working toward a constellation of sensors for the benefit of various applications, in particular in the climate and weather forecast domain. The GSICS effort started by prototyping a method for IR sensors inter-calibration (GEO-LEO). The effort continued approaching the other spectral domains, in particular VIS-NIR, recently UV and MW spectral domains are being tackled. Overview of GSICS database, deliverables and tools is provided, this includes, but it does not limited to: solar and lunar spectra, NRT inter-calibration and bias adjustment factors for the relevant GEO sensors, mainly using LEO as reference. Lunar calibration was mentioned as one of the highest priority issues being addressed, in particular for improving absolute radiometric accuracy and reducing the remaining geometry dependence (phase, libration). To this end, various activities are on-going, which includes the reprocessing of the ROLO telescope dataset and the use of new space-based lunar observations (e.g., from Pleiades) with the long-term goal of attaining full SI traceability. In conclusion, GSICS is a mature framework providing operational inter-calibration products to the user community.	

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Agenda Item: 1c Logistics information – 8:50 (10 minutes)	
Presenter	Jerome Bouffard (ESA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
Jerome explained the logistics of the meeting and associated social events kindly hosted by ESA.	

Agenda Item: 1d ESA EO (Earth Observation) Programme – 9:00 (30 minutes)	
Presenter	Henri Laur (ESA)
Overview	<p>HL remarked that ESA is pleased to be active member of GSICS, and this goes along the lines of the long-standing effort that ESA put on ensuring that its satellite products meet the desired data quality and are fit for the purposes of science exploitation. The overall ESA EO programme is presented, this is based on four main pillars: Future EO, Operational EO, Customized EO and Basic activities. Detailed explanation of each pillar is provided. Future EO activities include, in particular, new technology demonstrator missions (Earth Explorer), which are paving the way of future operational missions. Operational EO activities consist mainly on meteorological satellites and the Copernicus Sentinels missions, which are briefly described. HL reported the major challenges that ESA EO programme is facing, among those, the diversity and synergy challenges are of clear relevance for GSICS. Finally HL stressed the importance that Data Quality has in the overall EO Programme in order to ensure and maintain the credibility to the data, and quantify their accuracy following community accepted best practices.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
Q: Which is the largest community in EO for ESA products? A: The land users community is the largest.	
Q: Which community represents the majority of users registered on ESA's data portal?	
A: Land surface community has the most registered users - although it is not necessarily the most important.	

Agenda Item: 1e ESA CCI (Climate Change Initiative) Programme – 9:30 (15 minutes)	
Presenter	Jerome Benveniste for Pascal Lecomte (ESA)
Overview	<p>JB introduced the CCI programme, which was initiated as a response to UNFCC requirements. The first CCI programme tackled 13 ECVs, which are now being transferred to C3S for operations. Additional ECVs (e.g., lakes and sea surface salinity) are now being added as part of the CCI+ extended programme. The general method followed within CCI is presented: it starts with the choice of the algorithm, which is the result of a rigorous inter-comparison exercise (Round Robin), then the processing of the relevant archive starts, finally, the results are published in peer-reviewed journal and as soon as they reach the consensus within the science community they are started to be used by the end-users, e.g., policy makers and climate modelers. The goal is to realize the full potential of the EO archive, addressing UNFCCC needs. Achievements of CCI are recalled, in particular the large number of peer-reviewed articles, which are cited also within the IPCC report. Finally some example ECV long-term trend are shown, in particular sea level rise, whose trend has recently accelerating, depending mostly on Western Antarctica ice loss.</p>

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Discussion points, conclusions, Actions, Recommendations, Decisions

CCI created in response to UN Framework Convention on Climate Change (UNFCCC).

Agenda Item: 1f GOES-16/-17 ABI Calibration Performance and Updates – 9:45 (15 minutes)

Presenter Xiangqian (Fred) Wu (NOAA)

Overview Fred provided the latest updates of the in-flight calibration results of ABI sensor on-board GOES-16 and GOES-17 platforms for both the VNIR and IR channels. Concerning the VNIR calibration, a heating problem of G-17 caused some detectors not meeting the noise requirements, furthermore, an issue was observed in band 3 due potentially to FPM temperature variation. Concerning the IR channels, an issue was detected on G-17 satellite due to the loss of cooling capabilities. As a result, IR noise for G-17 can exceed the requirements set in the MRD. GEO-LEO and GEO-GEO inter-calibration using SNO observations are being used to assess IR calibration using the protocols prototyped within GSICS. In this context, it was underlined the relevance of having a similar sensor flying in the G-16 platform, since lesson learned and inter-sensor calibration can help resolving unforeseen calibration issues.

Discussion points, conclusions, Actions, Recommendations, Decisions

G16 navigation accuracy now well within specs for all channels (outside eclipse), but G17 still has unresolved issues - although this is not affected by the Loop Heat Pipe anomaly. However, this does impact the noise on a few VNIR detectors - although most perform well, as is their calibration. However, this anomaly has a more serious impact on the IR calibration, due most to temperature instability of detectors, but also scan mirror and black body (varies 298-323K). GEO-LEO IR comparisons under best conditions are good (<0.1K for most channels - except B16). NOAA are working to recover more data during the nighttime periods when thermal control is compromised - albeit compromised in noise performance.

Fred W. highlighted the benefit of GEO-GEO comparisons against GOES-16 and North-South Scans (NSS) to characterise striping caused by different detectors' responses.

Tim H. commented that the GRWG should work on agreeing algorithms for GEO-GEO comparisons between geostationary imagers operated by different agencies, which will be followed up in the break-out sessions.

[Q] EUM acknowledged the benefit of doing GEO-GEO inter-calibration, we need community accepted protocols across agencies for inter-comparing GEO sensors. Fred W. agreed that G-17 benefited from having G-16 already flying, in particular at the early stage of the mission, in order to anchor the radiometry to a well-characterized sensor. For the future, there will be a large number of GEO sensors to use for inter-calibration.

Agenda Item: 1g Fiducial Reference Measurements (FRM) Concept – 10:00 (15 minutes)

Presenter Philippe Goryl (ESA)

Overview FRM is a new concept being elaborated and promoted by ESA, which is now being adopted by other space agencies. The need for FRM started from the requirement of having satellite dataset, which are well characterized and whose products come with proper uncertainty estimate, so that to increase their credibility and ease their use within the user community. FRM are those validation data, which have been collected using metrological practices and

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	community-agreed protocols. An FRM must have a fully traceable uncertainty budget, ideally traceable to SI, and shall be fully characterized, meaning that all sources of uncertainties shall be properly identified and understood. ESA is currently running a large number of FRM products, e.g., FRM4STS, FRM4SOC, FRM4ALT, each one addressing one particular geo-physical variable and satellite measurement system. FRM is therefore a generic model, which is built thanks to the close cooperation with metrological partner (NPL in particular) and it is replicated in the various instances. This new concept set the stage for innovative and rigorous approach on the way satellite products quality is assessed. The long-term goal is to have a “FRM in space”, meaning a reference sensor against which all satellite can be inter-compared through a fully traceable approach, this is the vision around which the Truth and Clarreo missions are being defined.
Discussion points, conclusions, Actions, Recommendations, Decisions	
[Q] Could you elaborate on the meaning of well-characterized measurement? [A] Well characterized means to have a deep understanding of the uncertainty budget associated to your measurement, this includes not only the end-to-end calibration, but all elements in your processing chain (e.g., ancillary data).	

Agenda Item: 1h Aeolus Mission Status – 10:15 (20 minutes)	
Presenter	Jonas Von Bismarck (ESA)
Overview	Aeolus mission objectives are recalled; the scientific goal is to improve weather forecast by providing wind profiles in the troposphere and lower stratosphere. The mission was a technological challenge, since it was the first time a UV (355nm) Lidar was put in space. The measurement principle and orbit specifications are recalled, the platform is in sun-synchronous orbit at 320km altitude, with ascending node at 6PM (terminator), the sensor points off-nadir at 35 degrees to derive horizontal wind profiles at vertical resolution (adjustable) of 250m. Cal/Val and Data quality programme is illustrated including several ground, balloon and airborne-based campaigns. A dedicated Aeolus Cal/Val WS will be organized in ESRIN during 26 – 29 March 2019. First results are very promising and generally provides positive feedback to ECMWF model. The overall status is good, though the laser energy is slightly lower than optimal. Release of products to the user community is expected for Q2 2019, this includes in particular NRT wind profiles and optical properties of aerosol and cloud.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>(Q) Why the orbit terminator at 6PM? [A] It was a tradeoff choice between SNR and atmospheric dynamics.</p> <p>(Q) Why the pointing at 35 degrees and are there plans to use nadir observations? [A] This configuration was selected to have the best instrument performances; nadir observations are only for calibration purposes (once a week), though there are ESA ITT coming out on the potential use of this data for science.</p> <p>(Q) Is there a plan to use Google Loon wind data? [A] This may be of interest for validation.</p>	

Agenda Item: 1j Toward FCDR and uncertainties information for Altimetry – 11:20 (20 minutes)

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Presenter	Jerome Bouffard (ESA)
Overview	<p>Altimetry originally dedicated to study mean sea level rise over the ocean, is now being more and more used also to characterize dynamic of sea ice, coastal water and land hydrology. The basic concepts of altimetry measurement and processing scheme are recalled. The basic need for climate is to ensure harmonisation of various altimetry sensors, so that to allow studying trends over time. ESA is running a dedicated project on that, FDR4ALT, to improve accuracy, consistency and continuity of ERS and Envisat long-term altimetry data following QA4EO guidelines. The concept of Thematic Data Products (TDP) is introduced; the basic idea is to provide the users with a small sub-set of key geo-physical parameters with associated quality indicators, which are targeting dedicated user community. This concept was required to ease uptake of Cryosat products by the different scientific communities, and to tune the processing approach (including low level processing and calibration) to the needs of the targeted thematic area. Both FDR and TDP concepts are now being considered for all other ESA EO missions.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>(Q): EUM interest in the concept of L2+ processing level, are there commonalities in calibration processing for the different thematic products? Generally yes, though already low-level processing and calibration schemes need to be fine-tuned to the specific thematic areas targeted by the TDP.</p>	

Agenda Item: 1k Lunar Calibration Update – 11:40 (20 minutes)	
Presenter	Stefan Adriaensen (VITO)
Overview	<p>SA illustrated the goals of this ESA-funded project, which aims to acquire new lunar spectral irradiance measurements to improve models parameters for lunar calibration; the target is to attain a radiometric accuracy of <2%. A sun/sky/lunar CIMEL photometer is considered for this purpose, acquiring data in 9 channels in the spectral range: 340-1640 nm. This instrument was installed at the summit of Pico Teide (3555m) at Izana, in order to have very stable and clean atmospheric conditions. The instrument was calibrated at NPL to characterize linearity and the response was calibrated with using SI-traceable metrological standards. Iterative Langley plot procedure is used to estimate TOA signal, assuming a stable atmosphere during the measurements. Full analysis of the uncertainty budget will be carried out using rigorous metrological best practices. Already 400 irradiance measurements were acquired and the modeling is currently on going. The <i>Kieffer and Stone 2005</i> equation, the same used for the ROLO model, will be used for modeling. The model is about to be completed; next step will be comparison with satellite lunar measurements (from Pleiades and Proba-V).</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>(Q) How do you perform atmospheric correction? Only air masses are calculated, which are then cancelled out within the Langley plot procedure, the uncertainty associated to this method and the underlying assumptions are being fully characterized.</p> <p>(Q) Do you plan to make polarimetric measurements? In principle, we are capable of doing this type of measurements, but they are not planned yet, to be reconsidered in the coming months. This point will need</p>	

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to be further discussed during the dedicated mini-session on lunar calibration.

(Q) How long your measurements will last? The project is about to reach the end, though there are plans to extend the measurements to cover at least 6-years cycle

(Q) Are there plans to share the data? Yes, this is the current ESA policy, both the data and the ATBD will be publicly available

(Q) Observed increased noise for low phase angles, why? Possibly due to uncertainty in the model for these low phase angles, maybe need to limit range of applicability.

(Q) Plans to compare with ROLO parameters model? Clearly the results will be inter-compared with ROLO, since the same model is adopted.

Agenda Item: 1l ECMWF Copernicus Activities Related to Inter-calibration – 12:00 (30 minutes)

Presenter Bill Bell (ECMWF)

Overview BB presented the latest status of ECMWF reanalysis, in particular the ERA-5 and its improvements over the previous ERA-Interim. ERA-5 added many improvements, in particular the improved spatial resolution, which is now 31 km compared to 80 km of ERA-Interim; furthermore, more and better input data are used, resulting in hourly output provided with associated uncertainty estimate. ERA-5 is publicly available for the period 1979-2018 and can be of value for inter-satellite calibration assessment. Examples of improvements of ERA-5 are presented and inter-comparison with other reanalysis dataset are shown, such as MERRA-2 and JRA, showing overall good agreement, still some issues are observed for temperature anomalies in the upper stratosphere. The need for pre-processing satellite data is stressed in order to remove any residuals inter-sensor biases before the actual assimilation. Based on this lesson learnt, an innovative approach has been prototyped within C3S service, aiming to streamline and shorten the development cycle and the interaction between the data provider (e.g., EUM) and the end-users (C3S). The current cycle requires 2-3 years to detect and correct biases, a much more efficient approach would be to feedback issues in satellite consistency at early stage, working in close collaboration with the data providers. Within this new approach, an inner cycle of development is identified, where data providers and users work together to identify and addresses potential issues in satellite data formatting, calibration and quality assessment. This new concept is put forward as an innovative and effective approach for future service operations.

Discussion points, conclusions, Actions, Recommendations, Decisions

(Q) Are reprocessed satellite dataset being used within ERA-5? Yes to some extent, for the radiance measurements, ERA-6 will further make full use of this reprocessed dataset.

Agenda Item: 1m Quality Assurance for EO and CEOS Activities – 12:30 (30 minutes)

Presenter Nigel Fox (NPL)

Overview NF presented the QA framework for EO, which has been initially developed in the frame of CEOS and now it is being embedded into space agencies practices, in particular for satellite

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	<p>calibration and products uncertainty estimate. The approaches started within CEOS-IVOS, with the intention to develop community-agreed best practices for satellite data QA with the long-term vision of supporting the global observing system. The most stringent requirements were formulated by the climate community, in particular, the need of having trustable and consistent satellite data over decades and with traceable and fully characterized uncertainty budget. In order to attain this level of traceability, metrological practices need to be adopted following the guidelines defined within the QA4EO framework. As an example, the QA4ECV project was presented. Within this project, the level of trust on satellite data was summarised in the so-called <i>maturity matrix</i> concept, providing for each element of the calibration and processing chain the level of traceability. Similar approach it is now being considered also for assessing the level of maturity of ESA TPM missions in the frame of the ESA EDAP project. NF stressed on the need to work toward harmonisation of multi-sensors dataset, not homogenisation, meaning that sensor-specific features need to be preserved to avoid scene-dependent biases. The long-term goal is to have a set of fully inter-operable sensors. To this purpose, several projects started to tackle the various issues that are still preventing inter-operability. Among these projects, NF recalled RadCalNet, to provide a global network of TOA reflectance hyper-spectral measurements for inter-sensors calibration in the VNIR and SWIR range, the PICSCAR project, to ensure that common practices and protocols are used when applying vicarious calibration techniques over PICS sites, the MTF project to ensure common assessment of MTF for optical sensors. CEOS will oversee that all these elements follow a consistent and coherent methods and are integrated in the overall IVOS vision. A more ambitious project is the launch of a reference metrological sensor (Clarreo, Truth), providing space-borne traceable measurement in the solar spectrum, to be used as a reference for all optical sensors. Finally, NF reminded on the need of using a common terminology, there is a WG within CEOS to address the need to harmonize terminology, such as the use of uncertainty or errors, which are often misused within the user community.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
	<p>(Q) There was already a definition of FCDR in the scientific literature, why do you provide a more detailed and rigorous definition? (A) C. Merchant proposed this definition in the frame of Fiduceo project, discussion is currently on going and this definition needs to get approval from WMO and CEOS WG on Climate, this is expected during this year.</p> <p>(Q) Is there an effort to clarify other terms, which are often (mis-)used in the EO domain, such as accuracy and precision? (A) All these terms are in fact already well defined in the metrology community in a rigorous manner, though the issue is on to ensure that they are rightly used within the EO community, for this purpose a CEOS WG is fully dedicated to this objective.</p>

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Plenary GRWG+GDWG Agency Reports Session – PM on 4 th March, 2019	
Chair	Xiuqing “Scott” Hu(CMA)
Minute Taker	Dohyeong Kim
Attendance	Lots - see attendance register!
Remote Attendance	

Agenda Item: 2a Round Table Introductions + Logistics Info – 14:00 (20 minutes)	
Presenter	All

Agenda Item: 2b Agree Agenda & Minute Taking – 14:20 (10 minutes)			
Presenter	Xiuqing (Scott) Hu (CMA)		
Overview	Scott informed the agreed agenda of GSICS annual meeting 2019 including a new special session on re-calibration and re-processing and also introduced minute takers for each session.		
Discussion points, conclusions, Actions, Recommendations, Decisions			
Friday will be start 8:00 AM. All the minute takers should check Zoho docs before the sessions.			
Session		Chair	Minute Taker
Plenary – Mini Conference	Day-1-AM	Philippe Goryl	Fabrizio Niro
Plenary – Agencies Reports	Day-1-PM	Scott Hu	Dohy Kim
Plenary – Chairs Reports	Day-2-AM	Fangfang Yu	Fred Wu
Plenary – Reprocess/Recalibration	Day-2-PM	Tim Hewison	Sebastien Wagner
Plenary – Cross-cutting Topics	Day-2-PM	Mitch Goldberg/Toshi Kurino	Mitch Goldberg
GRWG – VIS/NIR (1)	Day-3-AM	Tom Stone	Sebastien Wagner
GRWG – VIS/NIR (2)	Day-3-PM	Dave Doelling	Raj Bhatt
GRWG – MW (1)	Day-3-AM	Ralph Ferraro/Manik	Cheng-Zhi Zou
GRWG – MW (2)	Day-3-PM	Qifeng Lu	Karsten Fennig/Tim
GRWG – MW (3)	Day-3-PM	Manik Bali	Tim Hewison
GRWG – IR	Day-4	Likun Wang/Tim Hewison	Tim/Likun
GRWG – UV	Day-4-PM	Rosemary Munro	Larry Flynn
GDWG	Day-3/4	Masaya Takahashi	Peter Miu
Plenary – Wrap-up	Day-5-AM	Larry Flynn	Fangfang Yu
Plenary – Wrap-up	Day-5-AM	Scott Hu	Tim Hewison

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Agenda Item: 2c ESA Agency Report – 14:30 (15 minutes)

Presenter	Philippe Goryl
Overview	Philippe introduced GSICS activities of ESA in the mini conference and the sub-group sessions (MW, VIS/NIR). There are five posters in the James Cook Room. VH-RODA (Very high -resolution Radar & Optical Data Assessment workshop) workshop will be hold in 18-22 November 2019.

Agenda Item: 2d CMA Agency Report – 14:45 (15 minutes)

Presenter	Scott Hu
Overview	<p>Scott presented CMA GSICS activities and achievements. FY-3D is commissioning phase after finishing tests for satellite platform in August 2018. The inter-calibration results of HIRAS and MERSI is reported.</p> <p>FY-3D commissioning is finished as all 10 sensors are well performance than the former sensors, and 8 payloads are now operational by L1 dissemination and L2 generation test. And sounding data (HIRAS ...) to deliver to ECMWF and so on. IR cal was updated by Likun's collaboration and Xu's spectral gap filling method. HIRAS shows high spectral accuracy by 2 ppm but find small spectral shift on orbit. Intercomparison with IASI is within 0.7K. RSB channels of MERSI-II is within 5% using vicarious calibration. Intercomparisons with MODIS are with 0.5 K except b24 0.8K. The bias of FY3D MWTS is better than 0.6K, AGRI IR biases less than 0.5K and b10 0.8K. GIIRS monthly bias is 0.25K and 0.42K with IASI (760-1050 and 1800-2188 cm⁻¹). GIIRS bias is - 0.2K with HIRAS.</p> <p>CMA lunar ground measurement will continue the long term observation with automatic control at Daocheng, Sichuan province. Lunar imager include 15 channels including Vis to MW.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

<p>Q: Plans to include CrIS in GEO-LEO to characterise diurnal variations in FY-4A AGRI?</p> <ul style="list-style-type: none"> • CrIS is already used but not operational, IASI is only used for operation. <p>FY-3E/HIRAS as early morning orbit will help further after its launch in 2020.</p> <p>Q: FY-3D and NOAA-20 will have chance to evaluate HIRAS to choose reference instrument</p> <ul style="list-style-type: none"> • Could support use of HIRAS as inter-calibration reference. <p>Q: Causes of biases in HIRAS-IASI - e.g. periodic features?</p> <ul style="list-style-type: none"> • Could be driven by environmental changes and/or changing optical alignment driven by solar illumination changes. • Comment (Hui Xu): Could also be driven by periodic gain changes.
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Agenda Item: 2e CNES Agency Report – 15:00 (15 minutes)

Presenter	Clemence Pierangelo (CNES)
Overview	<p>IASI-C cal/val will end in June 2019. Radiometric noise of IASI-C is similar or even better in some spectral band.</p> <p>CNES plans R&D study of moon calibration in the TIR band. A Moon radiometric model for TIR is currently being developed using the Moon data acquired during cal/val of IASI-A and IASI-B. She highlighted that PLEIADES-1B used to correct ROLO model albedo model for its phase</p>

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	dependency. And also IASI intercomparison with CrIS-NPP and CrIS-N20, shows the results of bias estimations, 0.2K in band 1 and -0.05K in band 2 and band 3.
Discussion points, conclusions, Actions, Recommendations, Decisions	
A.GRWG.2019.2e.1: CNES to report on progress with Lunar thermal infrared model study by 2020 meeting.	

Agenda Item: 2f EUMETSAT Agency Report – 15:15 (15 minutes)	
Presenter	Rosemary Munro (EUMETSAT)
Overview	Rose introduced the EUMETSAT participants in GSICS activities. She went on to provide an overview of EUMETSAT satellite programme, explaining the relationship between the Copernicus programme Sentinel-4 and -5, which will be hosted on EUMETSAT satellites from the mandatory programmes. EUMETSAT expect to also operate the CO ₂ monitoring Sentinel mission in the future once it is approved. EUMETSAT was provided the synchronization script for GSICS collaboration servers to CMA and ISRO.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Are Metop-A, -B, and -C in the same orbit?</p> <p>A: It was clarified that they are currently in an approximation to the so called Tristar configuration with the three satellites phase shifted by approx. 120 degrees and with the Metop-B and -C satellites both with a nominal descending node equator crossing time of 09:30 and with Metop-A now with in a drifting orbit. The drifting orbit will shift the descending node equator crossing time to 07:30 local time by 2021.</p> <p>Q: It was queried whether Metop-B and Metop-C would be put into a tandem configuration such as that used for a temporary period for Sentinel-3 A and B with the two satellites 30s apart, very useful for cross-calibration.</p> <p>A: No. This has not been considered for the Metop satellites.</p> <p>Q: Will Metop-A data continue to be processed and made available as it drifts towards the terminator.</p> <p>A: It was clarified that this will be done and that a number of EOL tests are planned before deorbiting of the satellite. The limiting factor for satellite operations is the thermal environment, whereby as a result of the drifting orbit the thermal conditions could become such that in the event of a payload switch-off, due to an anomaly, the on-board hydrazine might freeze.</p>	

Agenda Item: 2g ROSHYDROMET Agency Report – 15:30 (15 minutes)	
Presenter	Alexey Rublev (ROSHYDROMET)
Overview	Alexey reports calibration performance of MSU-MR for SWIR(2014.12.~2018) vs. AVHRR/Metop-A and IR(2016.12.~2018) vs. SEVIRI/Meteosat-10(-11), and GEO-GEO inter-calibration of IR ch MSU-GS/Elektro-L#2 imager using SEVIR/Meteosat-10,11 MSU-GS imager vs. SEVIRI amplitude of the daily calibration course less 0.2 K for BTs 300K and gradually increases to 1 K for BT 200K.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Likun W. encouraged the effort and will GEO-GEO will be discussed in IR subgroup session.</p> <p>Tim H. comments the new GSICS webpage of ROSHYDROMET is for registered users? Tim indicated that Russia cal/val webpage (http://planet.rssi.ru/calval) is not accessed from outside. GDWG will follow up the web page.</p>	

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Agenda Item: 2h ISRO Agency Report – 15:45 (15 minutes)	
Presenter	Pradeep Thapliyal (ISRO)
Overview	<p>Pradeep introduced new GPRC website of ISRO; "https://mosdac.gov.in/gsics", it needs to correct the link in the WMO GSICS website. Already generating NRTC and can plot in customised plotting tool. Will soon submit RAC to GPPA as demo products.</p> <p>Main contributions to GRWG are INSAT-3D image and sounder demo phase. And GEO-GEO carried out with INSAT-3D/3DR vs SERVIRI. GSICS DCC is implementation phase in collaboration with NASA. And ray matching method is almost completed. The issues are following :</p> <p>Exploring effect of conversion in radiance unit, non-linearity of GSICS correction is also issues. Also exploring possible nonlinear version of GSICS Correction.</p>

Agenda Item: 2i JMA Agency Report – 16:30 (15 minutes)	
Presenter	Masaya Takahashi (JMA)
Overview	<p>The GRWG activities of JMA : Himawari-8/9 AHI/IR Type-B uncertainty analysis is delayed. Migration of reference LEO from MODIS to VIIRS will be discussed.</p> <p>As for the GDWG activities, Masaya coordinate/develop specifications of GSICS formats / tools and will discuss GSICS Annual Calibration Report (Annual State of Observing System validated by GSICS inter-calibration approaches) and GSICS SRF netCDF Convention.</p> <p>Himawari-9 (in-orbit standby since Mar. 2017) and back-up operation of Himawari-8 for 2-days. Due to the impacts of GOES-17/ABI LHP problem on Himawari-9/AHI needs to be investigated in detail.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
JMA focuses on water cloud in vicarious calibration of AHI VNIR channels by MODIS. JMA is preparing for the Himawari-8 IR GSICS operational phase by uncertainty analysis.	

Agenda Item: 2j KMA Agency Report – 16:45 (15 minutes)	
Presenter	Dohyeong Kim (KMA)
Overview	<p>Dohyeong Kim (KMA) introduced the Demonstration phase of COMS/MI IR channel with IASI/AIRS, the update VI calibration in ray matching method and GSICS DCC based NASA algorithm and preparation of implementation of GSICS inter-calibration system of GK2A/AMI. He also indicated that COMS will be operational until March 2020. GK2A launched 4 December 2018 is under in-orbit-test and will be operational July 2019, the radiometric calibration of AMI was over and monitors the long-term trending. GK2A Image Navigation and Registration is on-going. In 2019 upcoming issue is that the preparation for the AMI radiometric calibration during commissioning period based on GSICS inter-calibration.</p>

Agenda Item: 2k NASA Agency Report – 17:00 (15 minutes)	
Presenter	Xiaoxiong (Jack) Xiong (NASA)
Overview	<p>Jack introduced NASA's main achievements and activities as following: improvements of pre-launch and on-orbit calibration, application of lunar observations, developments of new calibration methodologies and techniques, including enhancements of testing equipment and capability (GSFC), SBAF tool improvements, and improvements and applications of DCC methodologies.</p>

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Agenda Item: 2l NIST Agency Report – 17:15 (15 minutes)	
Presenter	Stephan Maxwell (NIST)
Overview	<p>Stephan highlighted the lunar calibration of two current thrusts of NIST effort: development and Installation of a NIST-traceable lunar observatory to complement ROLO Mauna Loa Observatory, 3-5 year trajectory to results; and Development of an airborne, high-altitude (~21 km) measurement system: air-LUSI. He reported the stellar calibration, measurement of spectra of stars for astronomy and for use in EO satellite calibration</p> <p>Measurements have been made at Mt. Hopkins (Arizona) with SI-traceable, top-of-the-atmosphere, spectral irradiance at the < 1% uncertainty level.</p>

Agenda Item: 2m NOAA Agency Report – 17:30 (15 minutes)	
Presenter	Fangfang Yu (NOAA)
Overview	<p>Quantifying differences between ATMS and AMSUs using ECMWF as a reference for double difference (e.g. TDR double difference is within 0.2K for SNPP, NOAA-20/ATMS CH11), and double difference using GPSRO is ~0.25K.</p> <p>In LEO-LEO inter-calibration, differences between NOAA-20/CrIS and SNPP/CrIS are less than 0.1K, differences from IASI-B are less than 0.2K, and those from AIRS are less than 0.4K.</p> <p>In GEO-LEO inter-calibration, the calibration difference is less than 0.1K among SNPP, NOAA20/CrIS and Metop-A,-B/IASI (for four instruments)</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
Q: NOAA GSICS Server mirroring other GPRCs products - status?	
A: Using ECMWF as a reference for double-differencing ATMS and AMSU	

Agenda Item: 2p USGS Agency Report – 18:15 (15 minutes)	
Presenter	Tom Stone (USGS)
Overview	<p>USGS is planning for a 3rd Lunar Calibration Workshop (2019).</p> <p>Tom presented the status of Landsat-7, -8 & -9 missions :</p> <p>responsivity trend and NEdT of calibrator on Landsat8 (OLI and TIRS)</p> <p>Landsat-9 has nearly identical copy of Landsat-8, part of SLI (Sustainable Land Imaging).</p>

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Plenary GRWG+GDWG WG Reports – AM on 5 th March, 2019	
Chair	Fangfang Yu (NOAA Affiliate)
Minute Taker	Xiangqian (Fred) Wu (NOAA)
Attendance	43 at start.
Remote Attendance	Unknown.

Agenda Item: 3a GCC Report – 8:30 (20 minutes)	
Presenter	Larry Flynn (NOAA)
Overview	<p>Larry reported that the number of registered GSICS users has been growing steadily in the past few years at a rate of ~25/year, reaching 377 recently.</p> <p>Several new deliverables are under review, including products to share SRFs & GEO-LEO IR collocations in NetCDF files.</p> <p>Four of the five GCC actions have been closed.</p> <p>GCC published four GSICS Quarterly last year. May reduce to three a year if there are insufficient submissions.</p> <p>There are new capabilities on the Action pages and new features on the Product Catalog pages.</p> <p>GSICS is being integrated into WMO WIGOS. Many documents to review.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Tim H. asked for the differences between the GSICS deliverables and products. Larry F. said that the products are more rigorous in documentation (such as ATBD) and other requirements.</p> <p>Scott H. asked whether deliverable needs no review. Manik B. confirmed that the appropriate subgroup would review. Dave D. commented that GSICS deliverables may not even be GSICS approved.</p>	

Agenda Item: 3b GRWG Report – 8:50 (20 minutes)	
Presenter	Xiuqing (Scott) Hu (CMA)
Overview	<p>Scott announced that the nominations of Chair (Scott Hu), Outgoing Vice Chair (Dohyeong Kim), and Incoming Vice Chair (Fangfang Yu) for GRWG have been approved at EP-19 in June 2018.</p> <p>There were 10 sessions and 121 items in last year's annual meeting, followed by 15 web meetings. He relayed the CGMS's recommendation of forming a Space Weather Task Team (SWTT) to incorporate space weather community to GSICS.</p> <p>Highlights for this year's annual meeting include special sessions on re-calibration & re-processing, and on strategy for incorporating inter-calibration in SWIR spectrometer. The MWSG will meet for full day in a parallel meeting.</p> <p>Looking into the future, he encouraged members to inter-calibrate with CrIS using gap filling, and to participate in the three forthcoming workshops: The SI-Traceable (Sept 2019 at UK NPL), the 3rd lunar calibration (TBD), and the pre-flight calibration (2020).</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Fangfang Y. reminded all that the Joint AMS and EUMETSAT Satellite Conference deadline for abstract submission has been extended to March 8.</p> <p>Tim H. asked whether we shall nominate POC for SWTT. Scott H. replied affirmatively.</p> <p>A.GRWG.2019.3b.1: Scott Hu (CMA) to ensure that POC for SWTT from each agency be nominated.</p>	

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Agenda Item: 3c JAXA Agency Report – 9:10 (15 minutes)	
Presenter	Hiroshi Murakami (JAXA)
Overview	<p>Hiroshi highlighted a broad range of JAXA's GSICS activities, including cross-calibration of GPM, SGLI and GOSAT-2 (very preliminary) lunar calibration by GIRO, TIR on SGLI cross-calibration by IASI and AIRS shows around 0.25K bias, as a results the show good SST accuracy around 0.3~0.4 K RMSD.</p> <p>JAXA now participates fully in both GDWG & GRWG. It launched several satellites last year with a number of new instruments. GCOM-C data release in Dec 2018, GOSAT-2 launched in Oct 2018.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Seb W. and Masaya T. thanked JAXA for sharing the SGLI inter-calibration results for both Vis and IR. Hiroshi M. thanked GRWG for GIRO.</p>	

Agenda Item: 3d GRWG IR Sub-Group Briefing Report – 9:25 (20 minutes)	
Presenter	Likun Wang (NOAA)
Overview	<p>Likun noted an increase of hyperspectral instruments (six types, ten in operation). The Narrow band ("multispectral") sounders (POES HIRS & GOES Sounder), broad band ("multispectral") imagers, and RTM are also within the scope of IRSG.</p> <p>IRSG planned for six web meetings and held four, and closed 70% of the actions.</p> <p>He pointed out several emerging issues, including gap filling with CrIS data; convolution error; extending the inter-calibration using IASI into the 3.7um channels; collocation; and machine learning.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Dave D. asked whether the SBAF will be incorporated into SRF NetCDF. Manik B., Masaya T., Fangfang Y., and Likun W. responded, but the discussions seemed to drift away from Dave's question.</p> <p>Likun W. noted that GitHub is easier to search than GSICS Wiki</p> <p>Toshi K. reminded all GSICS agencies to update their instrument landing pages. Mitch G. recommended that the web sites of the agency responsible for each instrument provide SRF information. OSCAR only provides links to the landing pages.</p> <p>Fangfang Y. asked whether J2 still has spectral gaps. Mitch G. said yes; NOAA CrIS models are very consistent.</p> <p>Ed K. commented that MW community would like to learn about sharing SRF. Fangfang Y. recommended contacting Masaya T.</p> <p>R.GVNIR.2019.3d.1: Dave Doelling (NASA) to clarify whether his concern or suggestion about SBAF has been fully addressed.</p>	

Agenda Item: 3e GRWG VIS-NIR Sub-Group Briefing Report – 9:45 (20 minutes)	
Presenter	Dave Doelling (NASA)
Overview	<p>Dave D. thanked ESA ESRIN for hosting the GSICS Annual Meeting.</p> <p>Spectral solar irradiance is an important issue for VNIR-SG. Dave D. went to a CEOS meeting on</p>

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	<p>the topic. After a lively and exciting discussion, little was agreed upon. Kurt T. suggested using Thuillier to be consistent with IVOS.</p> <p>Dave D. recommended having the calibration coefficients attached but not applied to L0. Otherwise users must wait for a long time for re-processing.</p> <p>NASA has generated new SBAF, which can be scene dependent.</p> <p>Lunar calibration: USGS on ROLO; NOAA on MTF; EUMETSAT on GIRO & GLOD.</p> <p>Dave D. would like to complete the DCC paper in the coming year and to begin expanding to SWIR. He will develop other plans based on agency priorities.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
Tim H. asked Dave's opinion on the ray matching technique. Dave D. replied that the topic will be discussed and promoted on Wed.	

Agenda Item: 3f GRWG UV Sub-Group Briefing Report & Introducing Special Session on Strategy for inter-calibration of SWIR spectrometers – 10:35 (20 minutes)	
Presenter	Rosemary Munro (EUMETSAT)
Overview	<p>Rose M. outlined the four baseline UV sub-group projects. These are: Reference Solar Spectrum, White Paper on Ground-based Characterisation of UV/Vis/NIR/SWIR spectrometers, Match-ups and Target Sites, and Cross-calibration below 300nm. NOAA (Larry F.) is leading the Reference Solar Spectrum and Cross-calibration below 300nm activities and EUMETSAT (Rose M.) is leading the White Paper on Ground-based Characterisation. Rose noted that NOAA had been most active in the last year and that EUMETSAT had faced resourcing issues in this area. Rose M. then presented the outlook for the UV Sub-group, noting that de facto the group was addressing spectrometers operating in the UV –SWIR range, not only the UV. She therefore proposed that the group be renamed to the Reflective Solar Spectrometer Sub-group, or similar, noting that all of on-ground characterisation, solar calibration, lunar calibration, inter-calibration, polarization, and development of common methods for use of pseudo-invariant targets & vicarious calibration sites (with a homogeneous surface over a sufficiently large area) would need to be addressed. She also noted that this is consistent with the CEOS WGCV strategy discussed in WGCV meeting #44 with GHG instrument L1 activities being carried out in cooperation with GSICS/UVSG and GHG L2 addressed under CEOS WGCV/ACSG. A special session on the strategy for inter-calibration of SWIR spectrometers to be held on Thursday at 15:00 was also introduced.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>There was in general a positive reaction to the proposal to rename the subgroup to reflect the scope of activities, and the interests of the members, more accurately with a focus on reflective solar spectrometers. Tom S. asked whether they will discuss this further on Thursday. This was confirmed. Tom S. said that lunar calibration should be extended to UV and to finer spectral resolution. Rose M. agreed and clarified that there was no intention to take over the leadership of the lunar calibration activities but rather to support in the area of UV and with spectrometer data. Fangfang commented that many participants are interested in both VNIR and IR sub-groups meetings and that it may become difficult to attend the parallel sessions.</p>	

Agenda Item: 3g GRWG Microwave Sub-Group Briefing Report – 10:55 (20 minutes)	
Presenter	Ralph Ferraro (NOAA)

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Overview	<p>Ralph F. apologized for not being at the meeting in person.</p> <p>On personnel, Ralph F. reported that the MWSG membership includes ~10 institutions; some have a large number of participants (NOAA 18, EUMETSAT 15). But he plans to step down as co-chair after this year. This is the 3rd year he has organized MW parallel session at GSICS annual meeting, and will be full day. He will go over a long list of actions in detail at the breakout session. He highlighted 8 talks at 4 web meetings and 3 articles published in GSICS Quarterly.</p> <p>In summary:</p> <ul style="list-style-type: none"> ● MWSG has grown and is still expanding. ● Continue to engage with other communities. ● Focus on methods to characterize MW sensors. ● Developing best practice, for example MW SNO. ● Matrix of deliverable products.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Tim H. thanked Ralph's enthusiasm, contributions, and leadership in the last three years, including the well planned web meetings last year and the full day MW session this week. It is regrettable that he cannot attend and chair the meeting in person.</p>	

Agenda Item: 3h GDWG Report – 11:15 (20 minutes)	
Presenter	Masaya Takahashi (JMA)
Overview	<p>Masaya T. noted that the GDWG is an advisory body for the EP. It has 14 members from 9 agencies.</p> <p>One major achievement is the Collaboration Servers at CMA, EUM, and NOAA. Only SEVIRI-IASI IR product is operational. KMA & JMA send their products to EUMETSAT. ISRO has a server since 2017 for its own products, and is working with EUMETSAT to become the 4th GSICS Collaboration Server.</p> <p>KMA created GDWG GitHub repository in 2017 for collaborative work.</p> <p>EUM developed GSICS Plotting Tool: only for Re-Analysis Correction so far, but ISRO is making it for Near-Real Time. EUMETSAT is also making it for VNIR via MICMICS.</p> <p>Instrument Event Logging is an effort led by Rob R. to develop a uniform approach for presenting, logging, and monitoring calibration. Calibration Landing Pages created by each satellite operators are linked to the WMO OSCAR/Space. There is a need to standardize nomenclature of the event logging and form a sub-group under the Event Logging Task Team and they should be discussed at CGMS meeting due to limited resources of the current GDWG.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Tim H. asked why the SRF NetCDF is on GSICS Wiki. Masaya T. said it's temporarily. Manik B. asked that since the agency SRF is not necessarily in NetCDF, do we link or re-format? Masaya T. said that will be discussed later.</p> <p>Toshi K. commented that GSICS supports calibration community whereas OSCAR supports users.</p>	

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Seb W. asked whether we should require agency to provide SRF in NetCDF format. Tim H. asked MWSG to consider that as an action. Fred added that the issue also applies to IR & VNIR.

Manik B. asked whether ESA could appoint a POC to GDWG. Phillipe G. said yes. Tim H. proposed that to be an action, which was accepted after some discussions.

Seb W. asked whether the PICS initiative from CMA is a tool or a data set. Lin C. said these are tools to predict and extract data, which cut down the data volume significantly.

R.GWG.2019.3h.1: GSICS members to provide SRF following GSICS Convention for link to GSICS and WMO OSCAR/Space.

A.GMW.2019.3h.1: MWSG to consider use of GSICS netCDF format for SRFs.

A.GDWG.2019.3h.2: ESA to recommend a member to GDWG.

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Plenary Special session on re-calibration/re-processing – PM on 5 th March, 2019	
Chair	Tim Hewison (EUMETSAT)
Minute Taker	Sebastien Wagner (EUMETSAT)
Attendance	As above
Remote Attendance	R. Roebeling (EUM), M. Burghoff (Univ. of Hamburg), K. Knapp (NOAA), R. Saunders (UKMO), K. Holmlund (EUMETSAT)

Agenda Item: 3i FIDUCEO Summary – 12:55 (20 minutes)

Presenter	Rob Roebeling (EUMETSAT)
Overview	<p>FIDUCEO = systematic use of metrology principles for climate data records based on EO data.</p> <p>Current FCDRs:</p> <ul style="list-style-type: none"> ● AVHRR FCDR ● HIRSpa ● MW sounders ● Meteosat VIS <p>To test those FCDRs, use of topical DRs:</p> <ul style="list-style-type: none"> ● Surface Temperature ● UTH ● albedo + aerosol (from Meteosat) ● Aerosol (from AVHRR) <p>The key is the uncertainty propagation following metrology principles. FIDUCEO investigated in depth the sources of uncertainties in all data processing levels, trying to establish detailed uncertainty trees.</p> <p>MVIRI FCDR:</p> <p>SRFs for the Met-2 to -7 recovered and reconstructed. Provided in NetCDF format. FCDR includes information on the uncertainties at pixel level.</p> <p>For SRFs, most of the degradation occurs in the shortwaves, up to 0.6 micron. Not all instruments degrade the same way.</p> <p>Rob showed the harmonised time series for the MVIRI VIS channel for all Meteosats. A problem is that the homogeneization depends on the target type that is looked at, due to the spectral dependence of the degradation.</p> <p>AVHRR IR FCDR:</p> <p>Status: pre-beta (i.e. not harmonised) version is available for NOAA-6 till -19 and from Metop-A and -B. Includes uncertainties info.</p> <p>Harmonisation work is still on-going. Planned delivery = Sept 2019</p> <p>ICT temperature correction is performed.</p> <p>HIRS FCDR:</p> <p>Status: pre-beta version is available (same as AVHRR)</p> <p>Harmonisation work is still on-going. Planned delivery = Sept 2019</p> <p>MW FCDR:</p>

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	Status: WP closed and FCDR is available. However, not harmonised as no time left for the project. But current version already very useful as the time series is more consistent and stable.
Discussion points, conclusions, Actions, Recommendations, Decisions	
2nd FIDUCEO workshop: will be held on 25-27 June 2019 in IPMA Alges - Lisbon, Portugal. To register: see link in presentation.	
To test dataset, contact Rob Roebeling at EUMETSAT.	
Q: Scott Hu: when recalibrating, is there any reprocessing of the geometry / navigation?	
A: for MVIRI not (at it started at level 1.5). As far as Rob knows, the other FCDRs were not reprocessed for geometry and navigation. Confirmed by M. Burghof.	
Q: Scott Hu: 2nd FIDUCEO WS is opened to everybody?	
A: Yes.	
Q: Lin Chen: what is the difference between FIDUCEO AVHRR reprocessing and PATMOS-X?	
A: PATMOS-X covers both VIS + IR. AVHRR FCDR does only IR. The added value of FIDUCEO was to provide the error estimates + correlations, which is not available in PATMOS-X. There are also different approaches in addressing the uncertainties from the instruments.	
Q: Is there any regridding?	
A: No.	

Agenda Item: 3j GEO-Ring: SCOPE-CM/IOGEO – 13:15 (20 minutes)	
Presenter	Rob Roebeling (EUMETSAT)
Discussion points, conclusions, Actions, Recommendations, Decisions	
SCOPE-CM activities on inter-calibration of geostationary instruments (GEO ring FCDR) for IR, WV and VIS radiances. All agencies with GEOs involved, except ROSHYDROMET.	
Objectives:	
<ul style="list-style-type: none"> - share common approaches for inter-calibration - re-calibrate - compare re-calibrated data in overlapping area - FCDR preparation 	
Rob presented the summary of the methods deployed by the various participants for VIS, IR and WV calibration. For VIS, EUM is the only agency that reprocessed all their data. Some results were shown for MVIRI and MTSAT on the IR and WV.	
Rob also presented the joint activity on IOGEO and GSICS. Some resources are needed to do the inter-comparison work. In the repository that has been set-up, most of the GEOs are available except Kalpana and COMS-1 for some time slots. Phase 2 is now finished. Other agencies are welcome to provide resources to contribute to the next steps of the project.	

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Individual agencies made great efforts on the re-calibration of their data. The project will continue. In particular there is a clear wish to pursue inter-agency collaborations. On the long term, a re-gridded inter-calibrated radiance dataset shall be generated, including as many GEOs as possible.

Q: Dave Doelling: there is a GSICS, IOGEO and a harmonisation adjustment. Correct? What is the difference between IOGEO and GSICS calibrations?

A: There is little difference as it is mainly the reference that is different. In IOGEO, HIRS/2 is used - either directly, or synthesised from IASI or AIRS observations.

Q: Dave Doelling: what are the ideas on harmonisation (SRFs are kept as such)?

A: one GEO instrument shall be selected to be the "reference". FIDUCEO recommends to use the harmonised approach.

Tim commented that there are tools for users to adjust the SRFs via SBAFs. Rob commented that once the SBAFs are available the harmonisation is simple for the IR. For the VIS, the spectral dependence makes the problem more complex.

Dave mentioned his strong interest in contributing to this activity and to see the outcome of the next ISCCP meeting.

R.GWG.2019.3j.1: Rob Roebeling (EUMETSAT) to consider removing seasonal cycles from IOGEO time series in order to check the stability.

Agenda Item: 3k Re-calibrating WV/IR channels of GMS/MTSAT imagers using HIRS/2, AIRS, and IASI – 13:35 (20 minutes)

Presenter	Masaya Takahashi (JMA)
Overview	<p>JMA operates GEOs since 1978.</p> <p>Recalibration experience:</p> <ul style="list-style-type: none">- VNIR = Vicarious calibration after GMS-5 using MODIS- IR: no experience ==> collaboration with EUMETSAT <p>Inter-calibration in the IR based on the GSICS GEO-LEO IR algorithm. However there are some differences such as SBAFs for HIRS/2 and spectral gap-filling for AIRS.</p> <p>Masaya presented more details about those differences. IASI-A is used as prime-reference. Double differences are used to bridge between the various reference sensors. Uncertainties are also tied to IASI-A. Long chains/bridges result in large uncertainties. Masaya showed the impact of these on the time series of the harmonisation. Plans for collaborations in GSICS in continuation of this project were also presented and need to be discussed and agreed.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
Tim congratulated JMA for this impressive work.	
Q: Have the variations in the NOAA equator crossing time has been taken into account?	
A: No, but this would only impact the older GMS satellites, which were spin stabilised, no large diurnal	

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calibration variations are expected. Fred commented that the early MTSAT were probably not impacted so much by the diurnal variation (NOAA did not observe it before GOES-7).

Q: Toshi: has JMA got some plans to collaborate with EUM on the VIS?

A: Yes, there are plans in the IOGEO project.

Agenda Item: 3I Inter-calibration for climate monitoring system - collaboration with ISCCP – 13:55 (20 minutes)

Presenter Ken Knapp (NOAA)

Discussion points, conclusions, Actions, Recommendations, Decisions

Progress on the ISCCP project, plus some results on GridSat and on the testing of GSICS adjustments

Ken provided very useful feedback on the use of GSICS data, including accessibility, ATBD usefulness, data contents and design of the GSICS websites.

One period was chosen for the assessment: 1 Oct 2013. Data availability was checked for GOES-13, -15, Met-7, MSG-3 and MTS-2. Depending on the instruments and agencies, data accessibility was more or less difficult (Met-7 was particularly tricky due to the non-availability of the calibration coefficients in the original L1 data).

Recommendations were made for data access (access protocols, documentation, categorisation [NRTC/RA/beta/etc.])

GridSat B1 CDR: (goal = gridded GEO inter-cal in the IR window using HIRS)

Ken presented the main aspects of the method (filters, scoring function). Score represents the mean difference between the given satellites and other satellites at 290K. Results of GridSat when using GSICS adjustments show no significant overall improvement compared to the baseline HIRS inter-calibration.

In a second part, Ken presented ISCCP calibration, with the main lines of the method (nominal, normal, absolute). Differences between GSICS and ISCCP are large, in particular for cold temperatures, for all satellites. The next step to understand those differences would be to tune the GSICS tables in the ISCCP algorithm. Ken also presented an interesting chart describing the harmony of the GEOs that represents the number of connections between satellites and the number of steps to "well" calibrated satellites. Can it be used to improve the calibration, in particular for the VIS band?

A series of questions were raised:

- are users the ultimate goal of GSICS?
- GSICS adjustments do not seem to lead to significant improvements
- ISCCP comparisons and testing still on going
- GEO harmonisation
- What about the VIS data?

Q: Tim commented that Ken's feedback is very valuable and asked how can this feedback be followed up by the GCC and GDWG?

A: Pete: will be addressed on Wednesday's session. Ken will send his slides to the GDWG.

Q: Toshi thanked Ken for his work, and pointed out that the difference between ISCCP and GSICS is very large. What could be the root cause?

A: Tim: This needs to be investigated directly with the involved agencies.

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A.GDWG.2019.3I.1: GDWG to check how to split follow up actions between GDWG and GRWG to address the feedback.

Comment by Dave: the naming convention for GSICS products is very difficult to handle by users.

Q: Mitch suggested to look at scattering diagrams to check the scene dependence of the temperature bias between GSICS and ISCCP

A: Agreed.

Q: Tim what are the plans for the newer instruments?

A: ISCCP will continue, implementing an ISCCP second generation project. Meeting will be organised in EUMETSAT, Darmstadt. Contact point: Rob Roebeling and Ken Knapp.

Agenda Item: 3m NOAA S-NPP/VIIRS v2 Processing – 14:15 (20 minutes)

Presenter	Sirish Uprety (NOAA)
Overview	<p>S-NPP VIIRS reprocessing status:</p> <ul style="list-style-type: none"> - version 1 completed. - version 2 on going. Plan = ready in July 2019. <p>Degradation over the 7-year life is very slow. RTA mirror degradation is stabilised.</p> <p>Solar spectrum used for the RSB autocal : MODTRAN/Kurucz for v1. For v2, Thuillier 2002.</p> <p>The main difference between the v1 and v2 were presented: solar spectrum, bias correction, filters for bias corrections (Kalman filter) combining lunar cal, DCC, solar diffuser, SNOx. The Kalman filter is a way to combine results from different methods. (Main difference from NASA processing).</p> <p>For SWIR bands, the SRRS (STAR Surface Roughness Rayleigh Scattering) model is used.</p> <p>Improvements between v1 and v2, e.g. EBBT LUT with better BT limits, smooth LGS gain for DNB, improved DNB radiances, straylight correction, etc.</p> <p>For geolocation, major improvement is for DNB but also to the other bands to some extent.</p> <p>Reprocessing on super computer from CICS/UMD: 1 month of VIIRS reprocessed in 15 hours.</p> <p>Radiometric Bias Correction: users are provided with 2 possibilities to correct the data: corrections from the OC group, or from the Kalman filter combined with radiance correction using SRRS model (depending on the bands).</p> <p>For distribution, an infrastructure was set-up with a data server but the data transfer is slow due to the data volume. New options (SIPS for instance) will be investigated to be more user friendly.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

Tim commented on the importance of such a dataset.

Dave Doelling thanked NOAA VIIRS team for establishing such a dataset.

Q: was there any comparisons between the NASA and NOAA dataset?

A: With version 2, the two datasets are in very good agreement both in terms of absolute scale and in trending.

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Raj Bhatt also commented also on the fact that now NOAA is using Thuillier in version 2. NASA and NOAA are collaborating for establishing the best approach for reprocessing. NOAA is in charge of the reprocessing.

A.GRWG.2019.3m.1: Sirish Uprety (NOAA) to report back on outcome of comparison of VIIRS v2 versus NASA SIPS dataset.

Q: Fred: it is understood that reprocessing will be based on the same IDPS and same navigation?

A: yes.

Agenda Item: 3n CMA's recalibration/reprocessing activities – 14:35 (20 minutes)

Presenter	Xiuqing (Scott) Hu (CMA)
Overview	<p>Scope: FY-1, -2, -3 reprocessing for FCDR generation for VNIR, IR and MW.</p> <p>Expected accuracy levels after reprocessing were listed for the various spectral regions.</p> <p>Rapid processing technologies are needed to support such an intensive reprocessing activity. Data record duration: 1999-2020.</p> <p>For MW, investigations allow identifying MWRI individual issues. Assessment for IR was done using IASI. For RSBs, assessment was done using Libya4.</p> <p>Comparisons of FY-3B/MERSI vs MODIS were done for RSBs.</p> <p>A first assessment of the re-calibrated dataset was presented for both the IR and the RSBs. GSICS algorithms will be used in this assessment. The next step will be to work on the TCDR.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Cheng-Zhi: what is the requirement of 1K for MW? Is it the bias?

A: it is the RMSE, including the noise. It is not the trend.

Q: Bill Bell mentioned that ECMWF will start the next re-analysis processing in 2023. So CMA work will fit nicely the time line. Interesting to compare the CMA and EUMETSAT datasets

A.GRWG.2019.3n.1: Bill Bell (ECMWF) to clarify time scale with the partner agencies for input data needed for ERA-6 activities.

Agenda Item: 3o Long-term calibration monitoring using UKMO NWP – 14:55 (20 minutes)

Presenter	Roger Saunders (UKMO)
Overview	<p>Roger introduced briefly the method, which involves a RTM (in this case, RTTOV). The main assumptions for the RTM simulations were listed.</p> <p>Only clear sky data are kept for the analysis. The satellites/instruments in scope: Met-8,9,10,11 SEVIRI, Metop-A/B IASI and HIRS, Aqua AIRS, NOAA 17 and 19 HIRS, AATSR.</p> <p>The excellent consistency over 10 years of data between IASI-A and -B for 925cm⁻¹ also shows the stability of both instruments. Similarly, HIRS channel 8 shows good consistency with IASI 928cm⁻¹ and Metop HIRS. For the 13.4 micron on SEVIRI on Met-10 the effects of the various decontaminations are clearly visible.</p> <p>Using the approach presented here, it is also possible to look at scan biases and scene dependences.</p>

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	IASI radiances make a very good FCDR. Roger congratulated EUMETSAT for this.
Discussion points, conclusions, Actions, Recommendations, Decisions	
Tim mentioned that this method could be pursued in GSICS and would need to be discussed.	
Q: Tim: the different treatment of cloud detection for the different instruments is important as it could contribute to the biases.	
A: Yes, but Roger trusts the cloud filtering.	
Tim invited agencies/teams to explore such an approach. This method can be applied to IR and MW.	
Q: Tim: what is the prospect for VIS channels as RTTOV can handle RSBs?	
A: Roger: certainly, it will be done in the future, but need to be investigated. Will also include GOME-2 once RTTOV includes the UV spectral region.	
Q: One concern is that NWP are more accurate where in-situ data are available. It relates to the spatial quality of the NWPs, depending on the availability of the in-situ data.	
A: Yes, indeed. It would need to be looked out. However, for the temperature NWP models are performing well. Need to look how the WV component has improved in the models.	
A.GMW.2019.3o.1: MWSG Chair to follow up the possibility to define best practices for the RTM inter-calibration method.	
Q: Is the data available to GSICS?	
- existing data - yes. Extra data by special arrangement	
Q: How to get ERA-5 observation residuals from ECMWF?	
- Through C3S Climate Data Store	

Agenda Item: 3p Discussion – 15:15 (20 minutes)	
Presenter	All
Discussion points, conclusions, Actions, Recommendations, Decisions	
A.GRWG.2019.3p.1: Fangfang Yu (NOAA) to set-up a web meeting to initiate a discussion on establishing a strawman algorithm for GEO-GEO inter-comparisons.	

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Plenary GRWG/GDWG Cross-cutting Topics – PM on 5 th March, 2019	
Chair	Mitch Goldberg (NOAA) and Toshiyuki Kurino (WMO)
Minute Taker	Manik Bali (NOAA)
Attendance	As above
Remote Attendance	R. Roebeling (EUM), M. Burghoff (Univ. of Hamburg), K. Knapp (NOAA), R. Saunders (UKMO), K. Holmlund (EUMETSAT)

Agenda Item: 3q GSICS Annual Report - way forward (e.g. incl. LEO and reference instruments) – 16:05 (20 minutes)

Presenter	Masaya Takahashi (JMA)
Overview	<p>Background:</p> <p>CGMS agencies have been reporting space craft status only but not on instrument performance. To accomplish this GDWG received an action to develop an approach for an annual GSICS report on State of observing System with respect to instrument performance. Masaya submitted a template to EP that was more or less accepted. Masaya prepared a comprehensive report by collecting instrument status from GSICS member agencies and had presented it to EP-19. Excerpts from the report were presented by Mitch to the CGMS. The goal of this presentation was to seek feedback from members and appraise them of the report.</p> <p>Concepts of Annual Report:</p> <p>Targets include non-experts on calibration, so report contents need to be simple. Contents include, satellite instrument events, radiometric calibration temperature bias and table summarizing bias for one year including time series.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

Masaya: Should all agencies include double differences?
 Subsequently Masaya highlighted every agency report.
 EUMETAT – SEVIRI performance for various GEO.
 NOAA- Only showed summary stats in December in 2018 ... this is because of ground update. But it can be generated for other periods.
 Mitch: Can two double differences using different transfers but same comparing instruments produce the same result?
 JMA: Did not have space for all six AHI channels so put only three in the slide. The table stats are only for 1 month but time series are over time of several months.
 KMA: Ray matching/DCC/SNO of COMS visible shows trend.
 ROSHYDROMET: Did not follow the template. But tables were provided.
 Masaya: For table what should we do 1 year average or 1 month average?

Masaya: For time series should we do 1 year or 1 month?
 Mitch and Manik proposed: Time series could be multiple years and means in the table could be max 1 year means.
 Mitch: Report was well received.

D.GWG2019.3q.1: GSICS Annual Reports should contain the following information: Mean Bias & SD - 1 year (or shorter in special cases) & Drift and Time series plots - full operational lifetime.

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Agenda Item: 3r WMO CIMO Guide Updating; PART III: Space-based observation – 16:25 (20 minutes)	
Presenter	Toshiyuki Kurino (WMO)
Overview	Purpose is to increase visibility of GSICS in WMO documents.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>CIMO Guide</p> <p>WMO secretariat provided an overview of the Guide to Meteorological Instruments and Methods of Observation (CIMO Guide). He pointed out that the CIMO Guide exists since 1954 and is widely used by well-informed meteorologists and technical experts in WMO member states who, however, are not experts in the various fields of observational instruments. He also stated that last update for Part III “Space-based Observation” dates back to 2014, it was underlined that there is a need to keep the CIMO Guides current. Recent updates on other Parts of the CIMO Guide will be approved in 2019. Updates have always been incremental and have been approved as soon after relevant bodies (the CIMO Guide Editorial Board) had reviewed and agreed the updates. GSICS community is invited to review and update the Part III/Chapter 6 “Calibration and Validation”.</p> <p>The new updates will include the “MEASUREMENT OF CRYOSPHERIC VARIABLES” as a new volume in CIMO Guide. It is expected that Space Weather will be included in future.</p> <p>WIGOS Guide</p> <p>The section 3.3.7 “satellites” of WIGOS Guide was updated with additional description on GSICS. It was approved in 70th session of the WMO Executive Council (EC-70) in 2018.</p> <p>Q/A</p> <p>Mitch: Who wrote the CIMO Guide?</p> <p>Toshi: The former officer, Jerome Lafeuille drafted with contractor Bizzarro Bizzarri.</p>	

Agenda Item: 3s GSICS Deliverables and GSICS Server Upgrade - requirements for new deliverables – 16:45 (20 minutes)	
Presenter	Manik Bali and Masaya Takahashi (JMA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Two presentations were combined in this single presentation. First Manik Bali described the GSICS deliverables. He then shared a proposed GSICS deliverable acceptance criterion. Four pending deliverables are:</p> <p>Hyperspectral Reference Radiance in NetCDF format</p> <p>By Masaya Takahashi (JMA)</p> <p>http://gsics.atmos.umd.edu/bin/view/Home/LEOnetCDFSourcedataset</p> <p>GEO-LEO Intermediate Collocation (Himawari/MTSAT V Hyperspectral)</p> <p>By Masaya Takahashi (JMA)</p> <p>http://gsics.atmos.umd.edu/bin/view/Home/GEOLEOIRCollocationIntermediatedata</p> <p>SRF for GIRO</p> <p>By Masaya Takahashi (JMA)</p> <p>http://gsics.atmos.umd.edu/bin/view/Home/SRfnetCDF</p>	

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Level 1C Inter-Calibration Tables

By Wes Berg (CSU) and Racheal Kroodsma (NASA)

<http://gsics.atmos.umd.edu/bin/view/Development/Microwave-Deliverable>

Masaya Takahashi focused on two main aspects of the deliverables:

1. Existing deliverables on the thredds server
2. Described the deliverables he has submitted (listed above) in detail and requested feedback on them.

Masaya also touched upon a key aspect of deliverable -- dissemination. The question was whether these should be disseminated by using the collaborative server or via a link provided by the deliverable producer. To take the acceptance process forward, It was agreed that the deliverables submitted would be discussed in the subgroup in the coming days and members feedback sought.

A.GCC.2019.3s.1: GCC (Manik Bali) to provide a detailed list of entities that can be classified as potential deliverables to the GSICS community.

Agenda Item: 3t New WMO GSICS Portal website – 17:05 (20 minutes)

Presenter	Toshiyuki Kurino (WMO)
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Discussion points, conclusions, Actions, Recommendations, Decisions

WMO secretariat provided information on the new GSICS portal site. The new site is still under development. However, it was already replaced with the previous site in the same address; <https://gsics.wmo.int>.

The resource for the new GSICS portal is outside of the WMO official website, so that it is feasible to update the contents by GSICS members by using the account id provided by WMO. The new site provides an interface of web based capability to update contents.

All the links stored in the “side bar” in the previous GSICS portal were moved to the “Links” page accessible from the top of each page. Links to the GSICS related documents are also stored in the “Links/Basic Documents”.

In the “Focal Point” page, names of nominated GSICS members are stored with their contact e-mail addresses embedded, so that one gets this by clicking on the hyperlinked surname.

A.GWG.2019.3t.1: Toshiyuki Kurino (WMO) to provide account access to update WMO GSICS website to GCC, GDWG and GRWG.

New Column added in OSCAR/Space database for linking to GSICS Calibration Status

WMO secretariat provided information on the new column added in OSCAR/Space database for linking to GSICS Calibration Status.

Agenda Item: 3u Collaboration with CGMS Space Weather Coordination Group – 17:25 (20 minutes)

Presenter	Toshiyuki Kurino (WMO)
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Discussion points, conclusions, Actions, Recommendations, Decisions

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Introduced the space weather instruments, some example products, inter-calibration method, challenges and path forward with the start to share specific period of data.

Ken (remote): Highlight the difference between meteorological and space-weather instrument inter-calibration. The main difference is on the instrument requirement.

Q: Fred: G16/17 magnetometers will be considered part of the space-weather instruments?

A: No.

ESA/ERSIN is interested in the collaboration with the inter-calibration.

Mitch: This is to share the GSICS experience in organizing the GRWG and working on the “best practices”, and work under GSICS frame work.

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GRWG VIS/NIR Sub-Group – AM on 6th March, 2019

Chair	Tom Stone (USGS)
Minute Taker	Sebastien Wagner (EUMETSAT)

Agenda Item: 4a Evaluation of GCOM-C/SGLI Lunar Calibration Using GIRO – 8:30 (20 minutes)

Presenter	Taichiro Hashiguchi (RESTEC)
Overview	<p>Since Dec 2018, data are available under https://gportal.jaxa.jp.</p> <p>SGLI is actually two instruments: SGLI-VNR and SGLI-IRS, with polarised measurements (3 angles for VNR-PL) for 0.6 and 0.8 microns.</p> <p>Lunar observations made every month after a pitch manoeuvre.</p> <p>0.15 degrees/sec pitch rate</p> <p>3 telescopes. Normally only the Nadir telescope is acquiring the moon. Once a year, roll angle is extended to cover left and right telescopes (+/- 24 degrees roll to put the Moon in each telescope).</p> <p>Phase angle = $\sim 7^\circ \pm 3^\circ$.</p> <p>Lunar calibration every 29 days over the 5 years of the mission.</p> <p>The comparisons between SGLI and the GIRO show a difference of about 5-6% for 0.865micron (VN11). In general, the lunar irradiance observed by SGLI is between 5 and 10% higher than the GIRO, similar to MODIS, VIIRS and PLEIADES.</p> <p>Degradation rate is about 1-3% for VN-01 to -06.</p> <p>For longer wavelengths (between 1050 and 2210 nm), the results are impacted by the phase dependence observed in the GIRO.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: was the on-board calibration compared with the lunar results for the trend?

A: analysis of the on-board calibration is on-going. Some work is on-going but the degradation of the plate has not been done yet.

Agenda Item: 4b Sentinel-3 lunar acquisitions – 8 :50 (20 minutes)

Presenter	Sebastien Wagner (EUMETSAT)
Overview	<p>Sentinel-3B manoeuvre performed on July 27 for moon calibration and straylight correction.</p> <p>Only one camera of OLCI (camera 4) saw the moon in a -6.46 phase angle.</p> <p>Cameras = spectral imagers, 2-D FPA has spectral and spatial information.</p> <p>Analysis:</p> <ul style="list-style-type: none"> a) pixel solid angle computed using optical system parameters <ul style="list-style-type: none"> - variation of Omega over the sensor spatial dimension b) oversampling by ellipse fitting (for now) <ul style="list-style-type: none"> - not ideal, intend to re-compute using telemetry (orbit & attitude info) - very clean signal for band 1 to 20 while showing band 21 clear limitation of the ellipse fitting method to derive the oversampling factor. Oa21 not understood yet. c) irradiance normalized at 800 nm

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	<ul style="list-style-type: none"> - also comparison with SCIAMACHY lunar spectra -- shows spectral variation at 900-1000 nm -- comment Tom: this variation comes from using the Wehrli solar model for back-conversion from lunar disk reflectance to irradiance, this is a topic of study by ROLO <p>OBS irradiance is higher than GIRO with same spectral pattern. Normalized irradiance shows that there is a larger difference for the band Oa21. SRF used by GIRO and reflectance spectrum smoothing mechanism is one of uncertainties on the GIRO simulation. GIRO drops down whereas OLCI has smooth behavior also observed in SCIA around 0.7 micron.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: How many detectors for moon measurement?</p> <p>A: OLCI has a camera system</p> <p>Q: Oversampling factor for Oa21 is different than for the other bands.</p> <p>A: The ellipse fitting procedure may be impacted by some artefacts in the image, maybe due to the straylight correction.</p> <p>Irradiance spectrum normalized at 800 nm: Tom commented that the spectral variations observed between 900 and 1000 nm come from using the Wehrli solar model for the back-conversion from lunar disk reflectance to irradiance, this is a topic of study by ROLO.</p>	

Agenda Item: 4c air-LUSI: Measuring Lunar Spectral Irradiance from a High-altitude Aircraft – 9:10 (20 minutes)	
Presenter	Kevin Turpie (UMBC, NASA)
Overview	<p>air-LUSI = airborne SI-traceable instrument above 90% of the Earth's atmosphere.</p> <p>2 main systems of air-LUSI: ARTEMIS (Autonomous Robotic Telescope Mount Instrument) and IRIS-IR (=instrument enclosure).</p> <p>Calibration was made before/after flights plus monitored during flight, including full assessment of the uncertainty budget.</p> <p>Lessons learned from engineering flights:</p> <ul style="list-style-type: none"> - hangar calibration issues (alignment, temp, stray light) that affected pre- and post-flight calibration. - insulation of fiber optics to minimise small temp effects - must add correction for atm effects during calibration - issues with the on-board calibration (will be tested) - protecting instrument from dust at take-off and landing, - etc. <p>Geometry: ARTEMIS generally tracked within $\sim 0.05^\circ$ Phase angle = 62°</p> <p>Spectral range: up to ~ 1 micron.</p> <p>Good SNR and precision of the measurement. Demonstration flight campaign planned in Fall 2019.</p>

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Discussion points, conclusions, Actions, Recommendations, Decisions

Q: fiber optics are known to be unstable when moved or in different thermal conditions, have you done something about this?

A: the fiber optic cable is blanketed and heated to keep it thermally stable, but this could be improved. The temperature dependence of the spectrograph system, including the fiber cable, has been characterised at NIST.

Q: optic fibers are sensitive to bending, etc. How was it handled?

A: Team was fully aware of the issues and included those limitations in the manipulation of the whole system. This was also the role of the permanent calibration monitoring to ensure that the impact was none on the measurements.

Q: what range of phase can they measure?

A: essentially they can consider all phases. Only limitation, is that the Moon has to be seen at night and the location of the flight also decides about the phase.

Q: Dave Crisp: will they broadcast the next flight schedule? OCO team would be interested.

A: yes.

Q: is the mini-workshop mentioned by Ken connected to the 3rd Lunar Cal WS?

A: the idea is to have the mini-workshop before the Lunar Cal WS and to report on the project at the Lunar Cal WS

Agenda Item: 4d Update on Lunar Measurements in China – 9:30 (20 minutes)

Presenter Xiuqing (Scott) Hu (CMA)

Overview Scott presented the status of the latest work performed on lunar calibration in China. These activities cover many aspects: instrument development, data processing and comparisons, organisation of the 2nd Lunar Cal WS. Scott presented the series of instruments that were developed and deployed for lunar observation, e.g. a Moon photometer. Comparisons show about 10% difference between GIRO and the photometer observations, in line with differences observed with other instruments.

CMA is leading an important activity in collaboration with other Chinese partners such as CAS. The objectives are to develop a new lunar calibration model both in irradiance and in radiance. Measurements are now acquired since 2017 automatically.

A new hyperspectral VNIR imaging lunar instrument is also being developed (SI-traceable demo), planned for launch in 2022. CMA is also developing an on-ground Moon observation system in Doacheng with instruments ranging from 0.55 to 12.5 microns.

Discussion topics:

- What measurements (ground and space-based) are needed to improve lunar calibration?
- What kind of instruments and specifications?
- How to be SI-traceable?
- How shall the data be processed?
- How to inter-compare measurements from different instruments?
- How those measurements/observations can be used to improve or be incorporated in the current lunar model?

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Discussion points, conclusions, Actions, Recommendations, Decisions

Tom thanked Scott and CMA for their efforts and for bringing up all the discussion topics.

Q: for night time, can the AOD lidar measurement be used?

A: yes, those measurements are used, in complement to Langley diagrams.

Agenda Item: 4f Lunar Calibration of GOES-16/17 ABI – 9:50 (20 minutes)

Presenter Fangfang Yu (NOAA Affiliate)

Overview Results from the nominal scan lunar images were presented for GOES-16 Moon is acquired in one swath, which is one of the 2 MESO nominal swaths. ABI Moon data is in L1Alpha products. Absolute phase angles are within 5 to 60 deg. B04 requires BDS relative detector position RDP shifting to get the moon round. Comparisons with AHI show some differences between the 2 instruments.

There are also some small variations in the space-look in B01. Some on-ground processing problems cause some outliers in the time series for GOES-16.

For GOES-17 desert and lunar calibrations show that G17 B03 is stable, whereas the solar cal shows some issues. This is currently under investigation. The focal plan temperature variability due to the LHP anomaly actually impacts the calibration, possibly diurnal and day-to-day.

Some seasonal variation seem to be seen in B05 and need to be investigated.

Discussion points, conclusions, Actions, Recommendations, Decisions

Seb commented that it would be nice to include in the time series a color scale to see the phase angle.

Dave commented on the quality of the RVS behaviour and thanked NOAA for the effort done on the GOES webpage to provide info to the users.

Agenda Item: 4e Prototype for MTF Using the Moon + Discussion – 10:10 (20 minutes)

Presenter Xiangqian (Fred) Wu (NOAA)

Overview Unfortunately, not much could be done on this activity since last year as the main resource (X. Shao) at NOAA left.

Moon is clearly a very good candidate to estimate MTF post-launch for GSICS sensors family (mostly GEOs for the moment). The objective is to establish a baseline to which agencies can compare their own assessment.

Members are needed to continue this activity, with an active participation.

The draft of MTF questionnaire was presented and will need to be discussed offline by end of March.

Discussion points, conclusions, Actions, Recommendations, Decisions

Tom S. commented on the fact that MTF involves people with knowledge on the geometry and the image processing. To work on the MTF within GSICS brings the group in a new direction.

A: This needs further consideration by the Research WG (and likely the EP). It could make the GSICS annual meeting even longer.

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Seb W. noted the possibility to present the status of the activity at the next IVOS meeting in Perth.

Jack X. questioned whether the effort is worthwhile within the GSICS since few people use the MTF. Usually, MTF is a spec for the instrument vendor. For users, PSFs are more important, e.g. for fire detection.

Clemence P. commented that for Pleiades, the use of the moon and star improved the radiometry. Understanding the MTF/PSF could also help in the radiometry.

Agenda Item: 4g Lunar Irradiance Measurements and Modeling Using an Aerosol Photometer – 11:00 (20 minutes)

Presenter	Stefan Adriaensen (VITO)
Overview	<p>CIMEL-318 with 9 channels has been operated since 04/2018. Possibility to have polarisation measurements.</p> <p>The main unknown uncertainty is the aerosol cycle. The results presented for the measurements combine the currently operated system with measurements done in the past by the University of Valencia.</p> <p>Regarding the model to be fitted by the data, it is the same formulation as the current ROLO. It means that only new parameters for the CIMEL bands will be derived. For the non-linear part of the model, the work is on-going.</p> <p>Next steps will include potentially the use of the GIRO and GLOD.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: are the aerosols from dust outbreaks not a problem?

A: AERONET data show that except a few times a year, the air is very clean.

Q: is the CIMEL instrument the same as the commercial instrument?

A: yes, but it has been adapted to be able to change the gain so that the Moon measurements can be done (normally used for the Sun).

Comment by Tom: one shall be careful when using the Apollo sample as it comes from a disturbed environment.

Stephen commented that air masses were limited from 2 to 5.

Stefan is considering using spectral measurements of Apollo samples to use as a basis for lunar reflectance.

Agenda Item: 4h TSIS-1 total and spectral solar irradiance observations – 11:20 (20 minutes)

Presenter	Odele Coddington (LASP)
Overview	<p>SI-traceability total and spectral solar irradiance observations, TSIS provides critical measurements for understanding solar influences on Earth climate. TSIS launched in Dec 2017 and started the commissioning phase on the ISS in Jan 2018. Improvements implemented for TSIS:</p> <ul style="list-style-type: none">- 3rd channel, exposed to the Sun twice per year (next is April 2019)- 21-bit ADC- electrical substitution radiometer as the detector

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	<p>- lab calibration with 0.2% uncertainty</p> <p>TSIS is an enhancement of SORCE. Spectral range = 200 nm up to 2400 nm. SRF resolution varies from channel to channel, ranging from sub~1nm in the UV to a maximum of ~40nm in the near-infrared.</p> <p>SIM spectral range covers ~96% of TSIS. First comparisons between TSIS SIM and other reference spectra show that differences exist. Some of these differences are within the uncertainties of the instruments used in the other reference spectra. For example, TSIS SIM first light compared to the LASP WHI spectrum (using SORCE SOLSTICE and SORCE SIM measurements) were within 5% in the UV and within 1% through most of the visible. In the near-infrared, however, TSIS SIM differs from the LASP WHI (outside of SORCE SIM uncertainties).</p> <p>In Dec 2018, a Compact SIM (CSIM) was launched on a 6U CubeSat. Very preliminary results of comparisons between CSIM and TSIS were shown (but no correction was applied yet). Performance is excellent so far, e.g. spectral alignment</p> <p>The absolute accuracy of the TSIS-1 measurements is about 0.2%.</p>
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Discussion points, conclusions, Actions, Recommendations, Decisions

Q: What about absolute accuracy in the interval 270-400nm?

A: 0.2% is for the full range of TSIS using pre-launch. However, post-launch needs to be confirmed.

Q: is SOLSPEC (older; i.e. the 'ATLAS3' reference) too high in the 2 micron range?

A: Yes, differences are about 8% with respect to the TSIS SIM spectrum (2017).

Dave Smith commented that this could help for SLSTR.

Q: open question: is TSIS providing products that meet the needs of the community?

Agenda Item: 4i Solar Spectra for Vis/NIR Calibration – 11:40 (20 minutes)

Presenter	Tom Stone (USGS)
Overview	<p>Some instruments use in their calibration equation a solar spectrum. This is the case of VIIRS or ROLO for instance.</p> <p>Commonly used spectra are:</p> <ul style="list-style-type: none"> - Thuillier 2003, based on SOLSPEC: VIIRS, Landsat OLI, etc. - Neckel and Labs - Wehrli, used by ROLO and GIRO. - Kurucz 2005, revised in 2010 - Build-in spectra in MODTRAN <p>In the Wehrli, there are some difference wrt Thuillier in the 900-1000nm area that could explain the deep in the GIRO simulation in that range.</p> <p>There is a new solar irradiance spectrum created by PMOD: SOLID (http://projects.pmodwrc.ch/solid). It is a time dependent model, endorsed by IVOS. But it implies a change in the approach implemented so far for the lunar calibration. In order to handle spectrometers or hyperspectral instruments, a higher resolution spectrum than Thuillier</p>

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	is needed.
Discussion points, conclusions, Actions, Recommendations, Decisions	
Should GSICS endorse a solar spectrum for VNIR calibration?	
Dave: is a temporal model needed when our uncertainties are higher than the solar irradiance variability beyond 350nm?	
A: a static model is enough for the moment in VNIR activities.	
Below 350nm, variability matters. Above, it is tenth of percent only for the solar variability. Remains the question of the resolution.	
Q: Can Odele create a static spectrum with a high resolution?	
A: Yes, she is willing to create a static solar model from TSIS data. This would have ~0.2% uncertainty absolute, SI-traceable	
A.GRWG.2019.4i.1: Tom Stone (USGS) to present a request to LASP to provide a reference solar irradiance spectrum based on the TSIS project (a static and high resolution solar spectrum scaled to TSIS).	
A.GRWG.2019.4i.2: Dave Doelling (NASA) to organise a web meeting and invite LASP to discuss on the progress for establishing a high resolution solar spectrum based on TSIS, with an estimate of the associated uncertainties. This spectrum is to be used in the VNIR activities.	
A.GRWG.2019.4i.3: Tom Stone (USGS) to organise a web meeting in conjunction with Seb Wagner in preparation of the next Lunar Cal workshop by the end of 2019	
A.GRWG.2019.4i.4: D. Doelling (NASA) to organise a web meeting on the DCC and the preparation of a paper.	

GRWG VIS/NIR Sub-Group – PM on 6 th March, 2019	
Chair	Dave Doelling (NASA)
Minute Taker	Rajendra Bhatt (NASA)

Agenda Item: 4j MODIS/VIIRS VIS/NIR calibration status – 14:00 (20 minutes)	
Presenter	Jack Xiong (NASA)
Overview	<p>Jack provided calibration updates on MODIS and VIIRS RSBs.</p> <ul style="list-style-type: none"> - VIIRS SDSM operates more frequently (no SD door) than MODIS. - SD calibration every orbit in VIIRS. - Semi-reprocessing of the Terra bands 1 and 2 LUT (2012-2017) in C6.1. - Earth-View based RVS are implemented to Aqua VIS bands in C6.1. - VIIRS V3.0.0 officially released in Aug 2018. - SD degradation is larger for shorter wavelengths in both MODIS and VIIRS. - SD and Lunar based calibration do not agree, thereby suggesting significant RVS issues in MODIS. - MCST will continue using Earth sites for RVS corrections in MODIS. - Aqua-MODIS performance is better than Terra MODIS.

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	<ul style="list-style-type: none"> - There will be Collection-7 release for MODIS dataset. - N20-VIIRS RSBs have negative biases compared to NPP-VIIRS. Biases up to 4% are observed.
Discussion points, conclusions, Actions, Recommendations, Decisions	
NOAA will switch to using Thuiller spectra for V2 dataset of NPP-VIIRS, while VCST might keep using the current solar model.	

Agenda Item: 4k NOAA STAR VIIRS Reprocessing Status and Updates – 14:20 (20 minutes)	
Presenter	Sirish Uprety (NOAA)
Overview	<ul style="list-style-type: none"> - NPP-VIIRS shows a discrepancy between Lunar and SD observations. - I3 calibration dropped by 1% after adjusting $c_0=0$ beyond May 9 2014. - SNPP-VIIRS to Aqua-MODIS intercalibration results show some trends, most likely due to degradation in Aqua-MODIS C6 dataset. - SNPP-VIIRS V2 reprocessing improvements include use of Kalman filter that allows long-term degradation correction for VNIR bands. - Other improvements include better RSBAUTOCAL F-factors and more consistent radiances with N20-VIIRS. - M5 and M7 calibration are going to be adjusted. - Kalman filter can predict F-factor degradation two weeks in advance. - NPP-VIIRS used DCC for confirming the effectiveness of Kalman filters, especially in M1 band that had a 1% drop in 2012.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>NPP-VIIRS M5 and M7 adjustment in V2 are concluded based on multiple calibration exercises as well as including inputs from scientific community.</p> <p>Reprocessed NPP-VIIRS V2 data and one from NASA SIPS are supposed to be consistent within 0.3%, as Jack said.</p> <p>Scott will host Chinese desert sites data of NPP-VIIRS V2.0.</p> <p>NASA Langley will host DCC data.</p> <p>Sirish's correction factors for V2 data are not applicable to the VIIRS data at CLASS.</p> <p>Use V2.0 NPP-VIIRS reprocessed data for cross-calibration studies.</p> <p>A.GVN.2019.4k.1: Sirish Uprety (NOAA) to provide correction factors for NPP-VIIRS datasets and a detailed documentation on using them.</p>	

Agenda Item: 4l Ice radiance technique for calibration monitoring and intercomparison – 14:40 (20 minutes)	
Presenter	Glen Jaross (NASA)
Overview	<p>Glen highlighted the potential use of East Antarctica site for sensor calibration.</p> <ul style="list-style-type: none"> - Pros: high reflectance, stable, small cloud fractions, uniform. - Cons: Useful only for 330nm to 800nm, applicable to polar orbiters only, high SZA, only used for certain months of year. - Scene selection based on low surface slope, uniformity, high reflectance. - Reference radiance is selected near solstice period. - Presence of clouds is statistically not important for his method.

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	<p>Absolute calibration: Ground measurement data from Warren at Dome C (Warren et al 1998, JGR)</p> <ul style="list-style-type: none"> - Spectral BRDF of surface for wavelengths 0.35-2.5 um - Surface BRDF transferred to TOA using RTM <p>Model uncertainty is ~2.5% below SZA<70%.</p> <p>Future work: Refine BRDF for improved performance</p>
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Agenda Item: 4n Evaluating NOAA-20 and SNPP VIIRS Radiometric Consistency for VNIR Bands – 15:10 (20 minutes)

Presenter	Sirish Uprety (NOAA)
Overview	<ul style="list-style-type: none"> - Sirish highlighted their DCC-based method to compute daily ratio of the two VIIRS channels. - Sirish thanks NASA Langley team for putting SBAF tool online. - Biases are computed for both VIIRS instruments relative to Aqua-MODIS using SNOs over poles. - M1 reflectance bias is -2.7% - N20 M4 reflectance is darker by 3% - M5 and M7 biases are -5.5% and -3.5%. - M5 is intentionally made darker by 1.5% based on the experience learned with NPP-VIIRS M5 band, which was over-calibrated. - I1 and I2 biases are -2.5% and -3.7% - These biases are supported by comparison over desert sites at low latitudes. - Biases computed based on daily DCC observations are similar.

Agenda Item: 4o Use of VIIRS in AHI vicarious calibration – 15:30 (20 minutes)

Presenter	Yusuke Yogo (JMA)
Overview	<p>Yusuke presented his early assessment results of switching to NPP VIIRS from MODIS as a reference for calibrating AHI VIS/NIR bands.</p> <p>Multiple approaches used: RTM simulations, SNO with VIIRS, DCC.</p> <p>Cloud retrievals done using CAPCOM software</p> <p>Reported some discrepancy: AHI B5 and 6 calibration overestimate reflectance compared to VIIRS counterparts.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

Yusuke used NOAA CLASS data for his inter-comparison.

Fred made a comment on how the liquid water clouds were detected in their method. Yusuke used a VIS radiance threshold for identifying liquid water clouds.

Sirish commented on the differences between 2.2um channels of MODIS and VIIRS.

Agenda Item: 4p Impacts of I01 and M05 of S-NPP/VIIRS on AHI-VIIRS Ray-matching – 15:50 (20 minutes)

Presenter	Kazuki Kodera (JMA)
Overview	<p>Kazuki presented JMA's status on RM calibration of AHI using VIIRS as reference. He used VIIRS data from NOAA CLASS and used NASA Langley's SBAF tool for spectral corrections. He successfully implemented NASA Langley's ATO-RM algorithm to AHI. He mentioned issue of</p>

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	using I1 channel: large data volume compared to M5. He reported a radiometric bias of 2.1% between M5 and I1 using AHI B3, which is consistent with what other agencies have seen.
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Agenda Item: 4q SBAF tool update – 16:40 (20 minutes)

Presenter	Rajendra Bhatt (NASA)
Overview	Raj presented annual updates on NASA Langley's SBAF computation online tool. The key highlight was newly added double spectral filtering tool that allows to extract a more precise and specific scene conditions from a mixed SCIAMACHY footprints. This would result in a more accurate SBAF and cross-calibration ratios. Raj illustrated the application of this feature with MODIS and VIIRS VIS and SWIR bands inter-calibration using clear-sky ocean, marine ice cloud, and marine water cloud scene types. Also presented an extreme use case of SBAF computation between a narrow DISCOVER EPIC channel and a very broad OSIRIS-ReX NavCam imager.

Agenda Item: 4r OLCI-A/OLCI-B intercalibration with DCC in tandem phase – 17:00 (20 minutes)

Presenter	Nicolas Lamquin (ACRI)
Overview	<ul style="list-style-type: none"> - Nicolas presented his DCC-based inter-calibration method for OLCI-A and -B. - S3A and B were in tandem orbit for four months with 30 sec time differences, thereby providing an opportunity for cross-comparison of onboard instruments. - Spectral characterization difference ~1nm between OLCI-A and -B requires homogenization between the twin instruments. - Image co-registration was done based on L1B lat/lon and reprojection on L3 grid, validated by image coregistration. - Bias between 1-2% reported in all bands with intra-camera effects. - DCC-based results agree very well with other approaches. - outlook is to use DCCs in independent statistics to assess absolute biases between the two instruments.

Agenda Item: 4s SLSTR VIS/SWIR channel calibration (including Deserts and Sun-Glint methods) – 17:20 (20 minutes)

Presenter	Dave Smith (RAL)
Overview	<p>Key highlights:</p> <ul style="list-style-type: none"> - Blackbody for IR and SD for VNIR calibrations - Vicarious approaches based in deserts and ice caps. - SLSTR 2.25 channels is significantly off from MODIS 2.13 channel - SLSTR-A vs AATSR bias is up to 12% for some channels. - SLSTR-B vs OLCI-B biases are up to 4% - Also presented his Sun-glint methodology, results are consistent with desert-based results. - Sunglint method is more useful for SWIR bands

Discussion points, conclusions, Actions, Recommendations, Decisions

Lin commented on using 6S RTM for computing atmospheric transmittance and suggested to ensure the effect of methane is properly accounted for the two 2.25 um channels of MODIS and SLSTR.

Agenda Item: 4t Towards harmonization of multi-sensor high resolution time series: the Belharmony approach – 17:40 (20 minutes)

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Presenter	Stefan Adriaensen (VITO)
Overview	<ul style="list-style-type: none"> - Used OSCAR method over Libya-4 for multiple sensors: S2A, S2B, L8, Deimos-1, ProbeA-V - Most bands agree within 2%. - S2A is slightly brighter than S2B. - Presented comparison of observed vs simulated reflectances over RadCalNet sites. - Satellites observations disagree by up to 10% over railroad valley site compared to ground measurements, possibly a BRDF effect - Over GONA, relative differences are up to 2.5%.

Agenda Item: 4u Review atmospheric radiative transfer models suitable for vicarious calibration – 18:00 (20 minutes)

Presenter	Yves Govaerts (Rayference)
Overview	<p>Yves highlighted the importance of consistency between theoretical RTM outputs with satellites radiometer measurements.</p> <ul style="list-style-type: none"> - Compared 6s-V, Libradtran, and RTMOM models. - Selection of RTM model can introduce 2% error on average (over Libya-4) - For L8, simulation agrees with observations over Libya-4 within 0.5% for 0.86 um. - Parallel plane model of atmosphere is invalid at large view and SZA conditions. - Characterization of surface topography, molecular absorption, polarization, improved surface and atmospheric characterization is a way towards a 1% RTM accuracy. <p>New open-source 3D RTM for Cal/Val activities</p> <ul style="list-style-type: none"> - Yves will be developing a new open-source 3D RTM (Eradiate RTM) for ground-target based sensor calibration. - Implement 3D representation of land, ocean, atmosphere, cryosphere - Will be completed in 3 phases - Will be available for testing during 2019-2021 (www.eradiate.eu)

Agenda Item: 4v DCC calibration paper discussion, and next year's web meeting discussions, Rayleigh scattering, DCC implementation in the NIR – 18:20 (20 minutes)

Presenter	Dave Doelling (NASA)
Overview	<ul style="list-style-type: none"> - NOAA reprocessed V2.0 data to be used for VIIRS reference. - Publish a joint GSICS DCC GEO calibration paper this year. - Will have a DCC web meeting later this year. - Looking for a volunteer for Rayleigh scattering calibration lead? - Welcomed everybody to suggest any new calibration approach for GSICS?

Discussion points, conclusions, Actions, Recommendations, Decisions

Seb reminded of a web meeting for Lunar Workshop.

Tom and Seb will lead the Lunar Workshop.

Fred asked if RadCalNet could be considered as PICS method. RadCalNet sites are instrument monitored small sites and might not be suitable for GEO imagers.

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GRWG MW Sub-Group – 6 th March, 2019	
Chair	Manik Bali (NOAA)
Minute Taker	Cheng-Zhi Zou (NOAA)
Attendance	Ed Kim, Raffaele Crapolicchio, Cheng-Zhi Zou, Mitch Goldberg, Qifeng Lu, Bill Bell, Roberto Sabia, Jerome, Bomin Sun
Remote Attendance	Misako Kachi, Ralph Ferraro, Isaac Moradi, Racheal Kroodsmas, Tony Reale, Alan Geer, Fabien Carminati

Agenda Item: 5a Round Table Introduction, Objectives, Agenda – 8 :30 (10 minutes)	
Presenter	Manik Bali (NOAA)
Overview	Manik welcomed the participants of the microwave sub-group and explained that the full day session had been arranged in part to fulfill actions from CGMS, which will be discussed later.

Agenda Item: 5b SMOS Cal/Val Activities – 08:40 (15 minutes)	
Presenter	Raffaele Crapolicchio (ESA)
Overview	SMOS CAL/VAL Activities
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>The speaker introduced the Soil Moisture Ocean Salinity (SMOS) mission. SMOS was launched on 11/02/2009. Mission status is good and mission operation is expected to be extended until end 2021. Instrument includes Microwave Imaging Radiometer Using Aperture Synthesis (MIRAS). The speaker introduced the MIRAS measurement principles and its processing characteristics, which transferring visibility function to brightness temperature (BT) of the scene. Calibration consists of the calibration of total power radiometer (LICEF) gain and offset along with reference noise signal provided by Noise Injection Radiometer (NIR). Calibration results suggest NIR noise signal stability within 1K, LICEF gain calibration maximum 5%, and an average less than 1%. However, spatial BT biases are significantly affected by the image reconstruction algorithm and the presence of land-sea contrast in the scene. Spatial biases need to be corrected at level 2 before to perform the sea surface salinity retrieval from BT. Calibration stability over Dome C area in Antarctic is within 1K for vertical polarization, horizontal polarization is affected (as expected) by geophysical signal. BT comparison among SMAP and Aquarius shows a good agreement over Dome C. Calibration team is expected to further reduce image spatial biases and to mitigate RFI effects in the near future.</p>	

Agenda Item: 5c SMOS Geophysical Products – 8 :55 (15 minutes)	
Presenter	Roberto Sabia (ESA)
Overview	SMOS Geophysical Products
Discussion points, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> The speaker gave an overview on L2/L3 SMOS products and validation procedure. These information are available on the SMOS pilot-mission exploitation platform (Pi-MEP). The presentation and website Information included L2/L3 soil moisture and sea surface salinity. The overall data quality is reasonably good. Specific calibration included land-sea contamination correction, a selection of single roughness model for version upgrade. Soil moisture validation consists of 50 networks, providing current and historical datasets. Ocean salinity validation uses 	

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ARGO float as an in-situ reference. Pi-MEP provides data visualization tool and validation matchup datasets.

- Questions: Data available real time to NOAA? Answer: yes, dataset can be accessed from relevant website.

Agenda Item: Assimilation of Microwave data in C3S ERA5 Reanalysis – 9 :10 (15 minutes)

Presenter Bill Bell (ECMWF)

Overview Assimilation of MW data

Discussion points, conclusions, Actions, Recommendations, Decisions

- The speaker talked about assimilation of MW data in C3S ERA5 reanalysis. Almost all passive MW data are used in the ERA5 reanalysis. There are ongoing efforts for satellite data reprocessing and data rescue at ECWMF for MHS, MWHS, ATMS and MSU. Satellite data rescue services will be delivered by SPASCI, ICARE, and MetOffice etc. Satellite bias correction for NWP and reanalysis are using FIDUCEO uncertainty information in VAR bias correction algorithms. Sounding data in ERA5 include MSU/AMSU-A/ATMS on all platforms. Humidity sounder include SMU-B, HMS on NOAA/MetOp; FY3-B, -C MWHS. A nice feature in ERA5 is it monitors satellite data and calibration drifts.
- The speaker also write down the variational bias correction equation in ERA5. Basically, bias correction is a linear combination of predictors where coefficients are derived in minimization of cost function. This is referred as constrained variational bias correction.
- Question: Drift in satellite bias correction in reanalysis appears to be larger than drift in satellite observations. Why is that? Answer: They are possible model drifts.

Agenda Item: 5e MetOp-C AMSU-A/MHS Status – 9 :25 (10 minutes)

Presenter Tim Hewison (EUMETSAT) Slides from Joerg Ackermann

Discussion points, conclusions, Actions, Recommendations, Decisions

- MetOp-C was launched on 11/07/2018 into a 9:30 orbit. After extensive calibration, agency recommends to release level 1 data. The speaker showed AMSU-A NEDT time series in which AMSU-A Channel 7 experienced large NEDT and noise in TB maps. Striping was found in MHS which was presents in all MHS instruments. Currently, the L0 and L0 products are complete and processed in NRT.
- Comments: AMSU-A channel 7 on MetOp-A and -B failed already. NOAA and EUMESAT shall compare with each other to confirm MetOp-C AMSU-A channel 7 performance. If necessary, get NASA and Northrop Grumman to investigate the channel 7 problem.

Agenda Item: 5f NOAA-20 ATMS Status – 9:35 (15 minutes)

Presenter Ed Kim (NASA)

Discussion points, conclusions, Actions, Recommendations, Decisions

- The speaker reviewed the current status of N20 ATMS. Overall, the ATMS NeDT are less than specification for all channels so far and N20 noise correlation is much better than S-NPP for all channels. Satellite maneuver was conducted with rolls 65° and 30° and a backflip maneuver. Results for investigated issues are all good. Details included antenna pattern and sidelobe check,

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sidelobe contamination, scan bias determined, reflector emissivity much better than SNPP, effect of mirror lunar intrusion not big, etc. Other calibration results include space view profile #1 declared optimal, channel NEDT stable and lower than SNPP, and noise power better than SNPP.

- Overall, N20 working well in all aspects. Maturity milestones reached earlier for N20.

Questions: Why N20 emissivity is better. Answer, hardware changes.

Agenda Item: 5g AMSR-2/AMSR-3 Update– 9:50 (15 minutes)

Presenter | Misako Kachi (JAXA)

Discussion points, conclusions, Actions, Recommendations, Decisions

- The speaker summarized JAXA effort in the development of AMSR series. Current AMSR-like sensors include MOS/MSR, ADEOS-II/AMSR, Aqua/AMSR-E, and GCOM/AMSR2. The Speaker provided an Overview of GCOM-W AMSR2, the successor of Aqua/AMSR-E. It was launched on May 18, 2012, joining A-train constellation. Its operational status is good and healthy, no major problem in data acquisition and processing was found and there are enough fuels to keep it in current orbit.
- AMSR2/AMSR-E products status: AMSR2 Level 1 and 3 brightness temperatures were upgraded to Version 2.2 in Aug. 2016; Level 2 and 3 geophysical parameters were upgraded to Version 2 in March 2015. AMSR-E level 1 and 3 BT was upgraded to Version 4 in April 2018; BT is not adjusted. Hot load has been corrected using two orbits path data (1 before and 1 after) for calculation; gaps are resolved.
- Products have been released to public in May 2018 through G-portal.
- Status of AMSR2 follow on missions: JAXA proceeds with internal process to launch development project. Time scheduling was provided in the presentation. Instrument specification will be equivalent to AMSR2, with finer FOV at 666 km altitude and 13:30 LT orbit. Intended for continuous long-term data record of the AMSR series.

Agenda Item: 5h MW Calibration Targets – 10:05 (20 minutes)

Presenter | Ed Kim (NASA)

Discussion points, conclusions, Actions, Recommendations, Decisions

- Motivated by NWP and FCDR requirement, the talks technology road path for SI-traceable calibration of satellite microwave radiometers. The approach is to develop NIST blackbody target, build the radiometers as linear as possible. Example for SI-traceable is that GPM is inter-comparison, not inter-calibration because GMI is not traceable to standard. The question to ask is for traceability to which SI unit in microwave radiometry. Only traceability to SI standard would be SI –traceable inter-calibration. Traceability to a standard implies absolute calibration. The current notation is that MW radiometry can be SI traceable to TB. Constellation systems need TB inter-calibration. There are some features that SI-traceable do not address including footprint, scaling, and amplitude.
- NIST blackbody calibration standard is traceable to SI Kelvin for 18-220 GHz range
Design requirements: maximize emissivity; minimize temperature gradients; variable temperature operations. Recent PhD dissertation by Derek Houtz contains more information on this. Formal standards for MW radiometer calibration: documentation ISO 20930:2018 approved, which provided space system calibration requirements for satellite based passive microwave remote sensing. It can be used potentially for: MetOp-SG radiometers, JPSS 3 and 4 ATMS

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- Question: Why not use standard on satellites: primary standards are too heavy

Agenda Item: 5i Joint activities with CEOS: Initial progress and example from FY3-MWHS2 – 10:45 (20 minutes)

Presenter	Jeiyang He and Qifeng Lu (NSSC/CAS)
Overview	
Discussion points, conclusions, Actions, Recommendations, Decisions	
<ul style="list-style-type: none"> • Speaker described CEOS/WGCV inter-actions and suggested next steps for further coordination: i) organize a joint research group ii) Standardize the calibration procedure; iii) Optimize the instrument design strategy and pre-launch calibration algorithm 	

Agenda Item: 5j FY-3 MWRI - Calibration and time series record – 11:05 (15 minutes)

Presenter	Shengli Wu (NSMC/CMA)
Overview	<p>Shengli provided an overview of the status of the MWRI instruments on FY-3D, which shows improved performance (noise) compared to its predecessors. Excessive signal in the space views was found to be associated with the Europe border at 10GHz and US/Canadian border at 18GHz, which are thought to be caused by TV broadcast satellite signals being reflected by the cold reflector. A correction has been developed, which reduced the difference between ascending and descending node data, as confirmed by NWP bias monitoring.</p> <p>Future MWRI instruments will have much bigger reflectors.</p> <p>Plan to reprocess MWRI with improved calibration processing to build time series data record for 2010-2020, including inter-calibration to reference sensor. This will be validated against GMI.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: What causes differences in SNO with GMI over land and sea? E.g. is it radiance-dependent? - Could be due to resolution differences - or orbit drift.</p> <p>Q: What is the reference for the inter-calibration for the FCDR? - Will use FC-3D.</p> <p>Q: Radiance-dependent analysis? - No - but could do.</p> <p>Q: Or latitudinal differences? - Could do.</p> <p>R.GMW.2019.5j.1: Shengli Wu (CMA) to analyse SNOs as a function of radiance and latitude.</p>	

Agenda Item: 5k Possible MW sounder references and their use for re-calibration of other satellites – 11:20 (15 minutes)

Presenter	Cheng-Zhi Zou (NOAA)
Overview	Cheng-Zhi first reviewed the requirements for a reference measurement, noting these could be different for weather and climate applications - the latter being much more demanding in terms

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	<p>of stability and longevity.</p> <p>The issues of orbital drift and seasonal cycles (related to cold calibration errors) is also critical for FCDR generation. Since stable orbits have been adopted the former issue has disappeared, as witnessed by ATMS-AMSU comparisons. Despite this, he noted that Metop-A and SNPP showed different trends during daytime and nighttime.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>The comparisons of microwave sounders on satellites with stable orbits provides a very powerful tool to understand the patterns of bias changes observed in other satellites - but also to other groups - e.g. GRUAN, ERA. Furthermore it could be used to better characterise the bias patterns seen by counterpart instruments (e.g. AMSU) or platforms with drifting orbits.</p> <p>Comment: NWP does not need absolute accuracy of 0.1-0.2K because they do their own bias correction - although it would benefit from better characterised/traceable accuracies to constrain the attribution of errors. Furthermore, technology advances and traceability may reduce the requirement of stability.</p> <p>- This led to a discussion on the trade-off between stability and accuracy requirements for reference instruments. The</p> <p>Q: Is difference in diurnal cycle expected from climate change studies?</p> <p>- Not asked</p>	

Agenda Item: 5l Review of Action Items/Ongoing Activities - Session will be a 'round table' addressing each action item - briefings by actionee expected – 11:35 (10 minutes)	
Presenter	Ralph Ferraro (NOAA)
Overview	In Ralph's plenary talk, there was a list of the actions and their status.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Due to time constraints, we did not go through these very closely, however, most of the active actions were highlighted by specific talks in this session.</p>	

Agenda Item: 5m Progress with GRUAN observations – 11:45 (15 minutes)	
Presenter	Bomin Sun (NOAA)
Overview	<p>Bomin introduced the GRUAN processing for radiosondes, which are intended to act as references with potential application to satellite cal/val. GRUAN working on full processing of new RS41 operational radiosondes to allow them to be tied to RS92.</p> <p>However, there is an ongoing need for GRUAN launches to be synchronised with satellite overpasses in different launch timing configurations.</p> <p>He presented some initial results, analysing time series of GRUAN sondes in MSU channel radiance-space. These correlated well with MSU observed trends in mid-troposphere, but much less well in the stratosphere.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Are the GRUAN radiosondes themselves different from regular sondes?</p> <p>- Yes, but operating procedures and processing. These are tied to special SI-traceable sondes via occasional comparisons.</p> <p>Q: How does quality of commercial aircraft data compare with GRUAN?</p> <p>- GRUAN has much better biases and comes with uncertainties.</p>	

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Q: In addition to validating the trend, Likun would like to see direct comparison of GRUAN v Satellite observations?

- will be covered in the IR session

Suggestion: Should compute trends at every level in radiosondes, then consider how to combine.

Q: Do you account for cloud contamination?

- not done as it is microwave

UKMO have synthesised 30000 GRUAN in radiance-space and would be happy to share.

Q: Have GRUAN tried processing regular operational radiosondes in the same way?

A.GMW.2019.5m.1: Bomin Sun (NOAA) to repeat analysis of time series with regular operational RS92 radiosondes and report comparison of results with those from GRUAN sondes.

Agenda Item: 5n GPM X-Cal LUT's/Deliverable – 14:00 (20 minutes)

Presenter	Manik Bali/Rachel Kroodsma (NOAA/NASA)
Overview	Manik introduced the proposed acceptance matrix and decision process for the Look Up Tables for GPM X-Cal as a GSICS Deliverable. Rachel then introduced the LUT, which covers the window and WV channels of a broad range of microwave imagers. These are based on cold and warm PICTs, applied independently by different groups (except for >150GHz, where only 1 tie-point is used).
Discussion points, conclusions, Actions, Recommendations, Decisions	
Q: Does deliverable describe all the methods? - this is described in the 2016 paper giving an overview of the methods used - provided as a reference Q: How are uncertainties provided in LUTs? - They are not. Should document the current state of the uncertainties - even if only the statistics of the fit Q: How much data is used to generate LUT? - typically 1 year - assumed static, and include checks for stability Q: Are SBAFs applied? - Spectral Response Functions (srfs) are accounted for in the Radiative Transfer Model (rtm). Q: Relative weighting of warm/cold scenes? Q: Could the same methodology be applied to MWRI? A.GMW.2019.5n.1: Rachel Kroodsma (NASA) to contact Wes Berg about sharing ATBD and university code with CMA. A.GMW.2019.5n.2: Shengli Wu (CMA) to attempt to apply X-Cal algorithms to MWRI and report on completeness of algorithm description (by 2019-09) and results (by 2020-03). A.GMW.2019.5n.3: Ralph Ferraro (NOAA) to re-send details of GPM X-Cal LUT deliverable to MWSG members for comment.	

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D.GMW.2019.5n.1: GPM X-Cal to be accepted as GSICS Deliverables, subject to positive feedback on completeness of algorithm description. A full GSICS product would need uncertainties to be included.

Agenda Item: 5o Inter-comparison of fast radiative transfer models and microwave observations – 14:20 (20 minutes)

Presenter	Isaac Moradi (NOAA)
Overview	Performed intercomparison of CRTM and RTTOV and a LBL model using input from ERA-5 over ocean only. CRTMv2.3 tended to perform best for the window channels, compared to ATMS - although the WV channels on S-NPP and N-20 showed much bigger differences than the differences between the models. Double differences confirmed the model differences tend to cancel out for most channels (except for window channels).

Discussion points, conclusions, Actions, Recommendations, Decisions

Double-differences with different RTMs very powerful to confirm differences between instruments - if the RTMs really are independent.

Q: What is the problem with ATMS WV channels? Huge differences between N20 & SNPP >1.5K

A.GMW.2019.5o.1: Isaac Moradi (UMD) to address large differences between N20 & SNPP WV channels with LBL model and compare the massive ensemble over the tropics.

Q: How is collocation interpolated in time?

- Mostly time averaged.

Q: Most difference come from ocean surface emissivity model in window channels?

- Yes - although both are using FASTEM - there are implementation differences - comparison may be improved by reducing time difference.

Roger recommended the development of a reference Sea Surface Emissivity model.

Bill Bell mentioned the RTM is relatively insensitive to spectral shifts in the WV channels (although they would be sensitive to shifts in the slopes of the passband).

Agenda Item: 5p The importance of a healthy microwave imager constellation – 14:40 (20 minutes)

Presenter	Mitch Goldberg (NOAA)
Overview	Mitch provided background on the concerns about the risk of a gap in the international constellation of microwave imagers, noting that if the CIMR and AMSR2 follow-on are approved the risk will be reduced (or at least deferred to the next follow-ons). He reviewed the channels and resolutions needed to address the requirements for different channel sets. The highest risk areas are for SST, which needs 6.9GHz channels, and salinity (which needs 1.4GHz). Continuity of AMSR-2 is important. ESA's proposal for a conical microwave imager (CIMR) with lower frequency channels for SST and soil moisture is absolutely critical. The enhanced capabilities for the Chinese MWRI will also greatly improve resilience.

Discussion points, conclusions, Actions, Recommendations, Decisions

Ralph pointed out the main benefit of the microwave imagers for ice types is through polarisation.

Comments: next MWRI resolution will be much improved due to much bigger 1.8m reflector and on FY-3E, -G and -P (on a lower orbit).

Comment: CMA compared Sea Ice products and found AMSR2 overestimate ice concentration.

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A.GWG.2019.5p.1: Mitch Goldberg (NOAA) to propose an international cooperation on sea ice products to CGMS.

Agenda Item: 5q Current and future use of microwave imager radiances in NWP models – 15:00 (20 minutes)

Presenter	Alan Geer (ECWMF)
Overview	Alan reviewed the use of microwave window channels (7-166GHz) in NWP (excluding sounding channels), which form part of the 20% contribution of all observations at ECMWF. He compared the use of these data at different NWP centres. One of the reasons more of this data is not used is due to partly overlapping orbits. He provided an outlook for the next 10 years - aiming to exploit more of these data, with coupled data assimilation - using surface and atmosphere models, including snow, sea ice and precipitation. He also highlighted the benefit of include AMSR3, CIMR, MWRI and potential DOD weather system follow-on.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Would be helpful to make the case for CIMR and AMSR3 to use NWP analysis to show impact on forecast skills of losing microwave</p> <p>- analysis shown in Slide 10 used to support case for AMSR3</p> <p>Q: Why not assimilate GMI?</p> <p>- because it is not sun synchronous</p>	

Agenda Item: 5r Current and future use of microwave imager observations in the Met Office NWP system – 15:20 (20 minutes)

Presenter	Fabien Carminati (UK Met Office)
Overview	Fabien review the history of microwave imagers and their use at the Met Office and planned use of future missions. His presentation provides a nice summary for each mission, with references in the form of clickable links. In some cases the L1 data is directly assimilated, in other cases L2 products were used. GAIA-CLIM included a comprehensive data quality evaluation of many of these instruments using both UKMO and ECMWF models, highlighting numerous instrument calibration issues. A bias correction scheme was developed for FY-3C/MWRI based on that used for SSMIS and resulted in data quality comparable to GMI (the best). The counterpart on FY-3D already looks good.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Comment from Ralph: Traditionally, NWP community uses 500 hPa anomaly scores to determine the impact of new observations. It would also be nice to see impact of microwave imagers on forecasting of major weather events (e.g., storm location, intensity, etc.) so we could see specifically how a certain sensor contributed to major weather events.</p> <p>- Fabien could investigate whether such cases are present in the assimilation experiments.</p> <p>Manik commented that this work complemented Tony Reale's analysis of GRUAN impact on sounders.</p>	

Agenda Item: 5s Objectives/Goals & Discussion – 15:40 (20 minutes)

Presenter	All
Discussion points, conclusions, Actions, Recommendations, Decisions	
Covered above	

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GRWG MW Sub-Group on WIGOS 2040 – 6th March, 2019

Chair	Manik Bali (NOAA)
Minute Taker	Karsten Fennig (DWD) + Tim Hewison (EUMETSAT)

Agenda Item: 5t Review of white paper outline and develop writing team – 16:40 (30 minutes)

Presenter	Manik Bali (NOAA)
Overview	Manik outlined planned contribution to CGMS baseline document on the requirements for inter-calibration products for microwave imagers.

Discussion points, conclusions, Actions, Recommendations, Decisions

The question of how L-band sensors could be included in this activity was raised.

A.GMW.2019.5t.1: Manik Bali (NOAA) to circulate white paper on microwave imager inter-calibration to all agencies for review/contribution.

Agenda Item: 5u WDQM – 17:10 (20 minutes)

Presenter	Mitch Goldberg (NOAA)
Overview	This agenda item was taken on Tuesday afternoon.

Discussion points, conclusions, Actions, Recommendations, Decisions

What documents can we generate to satisfy this requirement?

- Annual Report?

Can WMO issue DOIs for GSICS Documents?

- Not clear.

Agenda Item: 5v GSICS Document review by WIGOS – 17:30 (20 minutes)

Presenter	Toshiyuki Kurino (WMO)
Overview	This agenda item was taken on Tuesday afternoon.

Agenda Item: 5w Strawman outline draft of a plan to develop inter-calibration products for microwave imagers – 18:00 (20 minutes)

Presenter	Qifeng Lu (CMA)
Overview	Qifeng outlined the strawman structure of a white paper to propose Near-Realtime inter-calibration products for microwave imagers. He presented a list of existing algorithms that could be reviewed as part of this paper. This could be complemented by a team of L2 product experts to validate these products.

Discussion points, conclusions, Actions, Recommendations, Decisions

Cheng-Zhi pointed out the microwave sounders could be used as a reference for NRT applications - even for some imager channels.

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Agenda Item: 5x Discussion and wrap up – 18:00 (10 minutes)

Presenter All

Discussion points, conclusions, Actions, Recommendations, Decisions

Different application areas have different requirements for inter-calibration accuracy (and frequencies and spatial resolution). The GPM X-Cal method addresses the lower hanging fruits of the precipitation requirements, and may also be applicable to sea ice concentration applications. We have identified a way forward to extend this to CMA.

SST requires lower frequencies and higher accuracy - need

WV requires higher frequencies and higher accuracy - develop SNO method, following existing example.

A.GMW.2019.5x.1: MWSG Chair to coordinate the development of a summary of the current status of MW sensor calibration methods (by sensor and frequency type), needs by product type, and provide a 3-year roadmap for developing GSICS MW calibration products.

Agenda Item: 5y Co-Chairmanship – 18:40 (10 minutes)

Presenter Ralph Ferraro (NOAA)

Overview Ralph will be rotating off as co-chair, two viable replacements have been identified and are interested in becoming new co-chair, joining Qifeng Lu.

Discussion points, conclusions, Actions, Recommendations, Decisions

This agenda item was not discussed in detail due to time constraints. But proposals are welcome. Post meeting, an action has been added:

A.GMW.2019.5y.1: Ralph, Qifeng, Tim, Manik to identify and confirm new co-chair by May 1.

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GRWG IR Sub-Group on Cal/Val Status – 7th March, 2019

Chair	Likun Wang (NOAA Affiliate)
Minute Taker	Tim Hewison (EUMETSAT)
Attendance	<p>NOAA: Likun Wang, Fred Wu, Larry Flynn, Cheng-Zhi Zou, Fangfang Yu, Mitch Goldberg</p> <p>EUMETSAT: Tim Hewison, Alessandro Burini, Sebastien Wagner</p> <p>CMA: Qiang Guo, Hanlie Xu, Na Xu, Scott Hu, Qifeng Lu</p> <p>ESA: Philippe Goryl</p> <p>NASA: Tom Pagano, Xu Liu, David Crisp</p> <p>CNES: Clemence Pierangelo</p> <p>JMA: Kazuki Kodera, Yusuke Yogo</p> <p>KMA: Dohyeong Kim, Minju Gu</p> <p>USGS: Tom Stone</p> <p>RAL: Dave Smith</p> <p>ECMWF: Bill Bell</p> <p>DWD: Karsten Fennig</p> <p>SSEC: Liam Gunley</p>
Remote Attendance	None

Agenda Item: 7a Introduction to IR Sub-Group – 8:30 (15 minutes)

Presenter	Likun Wang (NOAA Affiliate)
Overview	Likun introduced the agenda, noting changes to presenters as below

Agenda Item: 7b AIRS Calibration Update and Radiometric Uncertainty Estimates – 8:45 (15 minutes)

Presenter	Thomas Pagano (NASA/JPL)
Overview	<p>AIRS is designed to produce SI-traceable observations.</p> <p>Presented radiometric accuracy for v5 product in support of IRRefUTable.</p> <p>Total number of channels varies during mission, but not monotonically.</p> <p>AIRS will end in 2022 as local equator crossing time on Aqua cannot be maintained after that.</p> <p>Q: Too late to influence decision?</p> <p>Yes - but not too late to influence EoL tests - e.g. May do manouever to allow full space views during EoL tests.</p> <p>Use of multiple space views during mission has improved knowledge of polarisation terms - which have been refined in more recent processing versions.</p> <p>v7 will be available in 2020.</p> <p>Partially-filled pixels assessed based on MODIS images on the same platform used to analyse spatial response functions.</p> <p>L1c v7 includes “reconstructed” pixels to fill gaps due to bad detectors, etc! Will be flagged in L1c dataset</p> <p>Tom introduced the new CubeSat IR Atmospheric Sounder (CIRAS) - looking for international collaborators</p>

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Discussion points, conclusions, Actions, Recommendations, Decisions

Q: What is the situation with L1c data availability and what issues are there in it for inter-calibration?

- L1c is produced in a 1 month rolling window, but will back process whole dataset
- Beware of reconstructed pixels - which are flagged as such

Q: Next ERA will start in 2023 - should it use v7 data?

- Biggest changes in cold scenes due to polarisation corrections

Q: spectral and spatial uniformity are linked - could include spatial nonuniformity in assimilation

Q: Can AIRS look at Moon?

- Yes - have lots but haven't figured out how to use it as need to account for spatial response - would be a suitable topic for PhD

Agenda Item: 7c FY-3D HIRAS measurement validation and monitoring – 9 :00 (15 minutes)

Presenter	Scott Hu for Chengli Qi/ Chunqiang Wu (CMA)
Overview	<p>A post-launch update to the fine alignment has improved the performance of this HIRAS so it now meets CMA's requirements in terms of bias and correlation noise.</p> <p>CMA generate full and reduced resolution L1 products.</p> <p>CMA used LBLRTM and MERSI cloud mask to check spectral calibration accuracy, which was also improved by the fine optical alignment.</p> <p>ISRF showed some contamination due to Silica gel gas - especially at 800cm⁻¹ >50%/yr, so performed decontamination in Dec 2018</p> <p>Used SNO pairing method to compare with CrIS - near nadir dx<5km dt<10min, scene uniformity SD<0.2K (MERSI)</p> <p>LW and MW small bias (<0.5K), SW band has bias ~1K</p> <ul style="list-style-type: none"> • Long-term SNO monitoring confirms this bias is stable over many months • However, O-B monitoring suggests it varies • One FOV shows larger biases <p>LEO-LEO comparison MERSI-HIRAS</p> <ul style="list-style-type: none"> • Uniformity check improved fit • Large bias (~1K) in some MERSI bands <p>FY-3E/HIRAS has some changes:</p> <ul style="list-style-type: none"> • 3x3 FOV • Higher calibration requirement • Early morning orbit • Planned launch 2020 <p>Suggested re-analysis comparisons all use ERA</p> <p>By mid-2019 ERA will be available with 2-5d lead-time</p>

Agenda Item: 7f Spectral gap-filling and Convolution Update on IASI-C Cal/Val activities – 9 :30 (15 minutes)

Presenter	Xu Liu (NASA)
Overview	<p>Xu first defined the convolution errors due to spectral gaps, finite spectral resolution and overlapping SRFs, as distinct from errors due to uncertainties in instrument characteristics (e.g. SRFs)</p>

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	<p>Use PCRTM, covers 50-3000cm⁻¹ in TIR and 250-2500nm in RSB</p> <ul style="list-style-type: none"> ● Fast model with small biases at <2750cm⁻¹ and RSB <p>Xu then presented results of convolution errors when simulating MODIS channels</p> <ul style="list-style-type: none"> ● For AIRS Up to 1K in some channels with AIRS gaps ● For CrIS error are reduced when using unapodised CrIS compared to heavily apodised Blackman <ul style="list-style-type: none"> ○ Strongly recommend considering this before proposing SRF shifts ● For IASI <1mK for most channels - basically not an issue <p>Modelling SW band in daytime is very sensitive to NLTE effects</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Are there errors in current GEO-LEO IR comparisons due to this?</p> <ul style="list-style-type: none"> ● Not with IASI ● But some with CrIS - and certainly AIRS <p>Q: progress with SW extension?</p> <p>A.GIR.2019.7f.1: Xu Liu to apply convolution error analysis to all ABI, MERSI and AGRI IR channels.</p> <p>A.GIR.2019.7f.2: Xu Liu to work with NOAA and EUMETSAT to apply gap-filling method to extend IASI coverage for AVHRR and SLSTR SW channels.</p>	

Agenda Item: 7d Update on IASI-C Cal/Val activities – 9 :30 (15 minutes)	
Presenter	Clemence Pierangelo (CNES) (with input from Dorothee Coppens (EUMETSAT))
Overview	<p>Clemence shared preliminary results from the commissioning of Metop-C/IASI, which was slightly delayed due to the need to switch to the redundant side of some electronics due to a failure.</p> <ul style="list-style-type: none"> ● Radiometric noise very good - similar to IASI-A & -B and expected to further improve after decontamination ● Geometric calibration checked against AVHRR confirm <0.1 pixel ● Radiometric calibration of the onboard imager (IIS) also checked and very good ● Inter-pixel cross-talk checked by viewing Moon in different iFoVs - confirmed requirement met ● Inter-pixel radiometric calibration checked comparing bulk mean radiances - confirms no wild pixels ● Spectral calibration is multi-step and still in progress. Initial results look good (mostly <2ppm) <ul style="list-style-type: none"> ○ Expected to be further improved by fine tuning ● Inter-calibration with N20/CrIS shows very similar results to IASI-B ● Analysis of impact of compensation device confirmed better results with it disabled - so it will remain so ● Metop-A/B/C currently in tristar configuration, <ul style="list-style-type: none"> ○ but Metop-A drifting towards trident ○ and expected to adopt Trident configuration after commissioning. ● End of Cal/Val officially expected in June 2019
Discussion points, conclusions, Actions, Recommendations, Decisions	

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Q: Comparison with AVHRR - was the AVHRR geolocation error accounted for?

- Not for absolute, but for relative geolocation to use imager cloud info

Q: Can Moon data be shared? Q: Share slides on GSICS Wiki?

- TBC

Agenda Item: 7e First Geostationary Infrared Hyper-spectral Measurements: In-orbit Validation Method for Radiometric Accuracy and its Preliminary Results – 9:30 (15 minutes)

Presenter	Qiang Guo (CMA)
Overview	<p>FY-4A/GIIRS has 128 detectors - will be changed for FY-4B/GIIRS with improved resolution</p> <p>GEO-LEO/Sounder comparison</p> <ul style="list-style-type: none"> ● Uses GSICS SNO baseline algorithm with customisations: <ul style="list-style-type: none"> ○ Identify exact overlaps ○ Remove cloud contamination using weak O₃ band at 1043 cm⁻¹ to select clear sky only ○ Spectral transformation - but needs work ● Qiang showed results of mean bias over MW and LW bands compared to IASI: <ul style="list-style-type: none"> ○ MW up to 1K difference - varies month-month ○ Breakdown by detector- no obvious patterns, but column 3 might be slightly better ● Long-term mean bias wrt IASI shows larger SD at edges of both bands <ul style="list-style-type: none"> ○ Excluding these mean bias 0.25 K and 0.42 K for 760-1050 cm⁻¹ and 1800-2188 cm⁻¹
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Have O-B statistics been checked?</p> <ul style="list-style-type: none"> ● Not yet <p>Q: How to use Ozone channel to do cloud detection?</p> <ul style="list-style-type: none"> ● Compared radiances around this line from IASI and GIIRS <p>Q: How to trade-off quantity v dynamic range - all sky/clear sky?</p> <ul style="list-style-type: none"> ● Could use both clear and cloudy - clear for spectral inter-calibration, cloud to cover fully radiometric range. <p>Q: How is off-axis correction addressed?</p> <ul style="list-style-type: none"> ● Not corrected at present- need another 1-2 	

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GRWG IR Sub-Group on Hyperspectral IR Inter-calibration – 7 th March, 2019	
Chair	Likun Wang (NOAA Affiliate)
Minute Taker	Tim Hewison (EUMETSAT)
Attendance	as am session
Remote Attendance	None

Agenda Item: 7g IR Reference Uncertainty and Traceability Report (IRRefUTable) – 10:30 (30 minutes)	
Presenter	Tim Hewison (EUMETSAT)
Overview	Tim gave the updates on IR Reference uncertainties and traceabilities Report. He suggests reporting the results using a consistent way (standard table). He also showed an example of JMA double difference results. He raised a question of whether we need extend the time range.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>CNES changed the POC with Clemence - who can provide IASI uncertainty analysis by end 2019.</p> <p>O-B: adding Dorothee.</p> <p>GEO-LEO: Target date to provide the table results:</p> <ul style="list-style-type: none"> Fangfang, Na (08/2019), Minju (04/2019) NWP Double difference: Fred Wu should be crossed out. Aircraft double differences: More IASI and CrIS field experiments should be added. <p>D.GIR.2019.7g.1: It was agreed to use the period 2013-03/2017-03 for the initial IRRefUTable analysis to be performed in 2019, then aim to issue an update in late 2020 to include at least 1 year of data with IASI-C, N20/CrIS and HIRAS.</p> <p>A.GIR.2019.7g.1: Mitch Goldberg (NOAA) to confirm the person to provide NWP and SNO method results to IRRefUTable report.</p> <p>A.GIR.2019.7g.2: Bill Bell (ECMWF) to consider providing results from ERA-5 to IRRefUTable report.</p> <p>Q: Fred Wu: What are Tandem SNOs?</p> <p>A: May be Aqua-SNPP situation that one catches another.</p> <p>Tom: Will IASI-B be reprocessed back?</p> <p>A: Not possible as not all interferograms are transmitted to the ground</p> <p>A.GIR.2019.7g.3: Mitch Goldberg will provide the document or information on CrIS operational data change during CrIS operational time.</p>	

Agenda Item: 7h Mutual Evaluation between the imager and hyperspectral sounder at the same platform FY-3D and FY-4A – 11:00 (15 minutes)	
Presenter	Hanlie Xu (CMA)
Overview	Hanlie highlighted the various benefits of performing multiple comparisons between hyperspectral and multi-spectral instruments on GEO and LEO platforms in terms of geolocation and radiometric consistency. For example, AGRI shows good consistency with GIIRS (bias <1K). The changing shape of FOVs at high scan angles can be accounted for using Line Of Sight collocation method to improve quality of collocations.

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	Comparisons of MERSI-HIRAS showed strange stripes, caused by nonlinear differences between different FOV.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: FOV-dependence could be scan dependence of scan mirror - may need to review thermal emission of mirror.</p> <ul style="list-style-type: none"> - also seen on VIIRS and MODIS - could also include polarisation effects <p>Q: Why are the scene-temperature dependent biases common to all channels?</p> <ul style="list-style-type: none"> - 13.5µm very sensitivity to SRF - potentially contamination <p>Q: LOS collocation method only for satellites on same platform?</p>	

Agenda Item: 7i Double Difference of inter-calibration comparison results of COMS/MI using before and after reprocessed CrIS data for 2015	
Presenter	Minju Gu (KMA)
Overview	<p>Minju reported statistically significant differences in WV and SWIR channels, which are radiance-dependent. Diurnal variations were also analysed and showed daytime results were most stable than night.</p> <p>Summary of the key results are 1) Small mean TB biases of (COMS/MI-CrIS_before) and (COMS/MI-CrIS_after) is < 0.04K for IR1, 0.01K for IR2, and -1K for WV, and the same seasonal variation for TB bias for CrIS_before and CrIS_after, 2) Double Difference between (COMS/MI-CrIS_after) and (COMS/MI- CrIS_before) for RAC data during 2015 0.028K for IR1, 0.022K for IR2, 0.019K for WV, and 0.041K for SWIR, 3) Double difference for diurnal variation shows a larger variation in the night time than that in the day time</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Could include in IRRefUTable?</p> <p>A.GIR.2019.7i.1: Minju Gu (KMA) to tabulate CrIS double difference results before/after reprocessing to include in IRRefUTable.</p> <p>Q: Slide 4 - what are the error bars?</p> <p>Q: What causes the diurnal variations?</p> <ul style="list-style-type: none"> - Thermal stresses on spacecraft introduce seasonal and diurnal variations, which occur around time of CrIS overpass. <p>Q: Why is the dynamic range smaller for WV and SWIR channels?</p> <ul style="list-style-type: none"> - Could be explained if a homogeneity test was failed due to high instrument noise <p>A.GIR.2019.7i.2: Minju Gu (KMA) to check whether homogeneity tests limit cold end of dynamic range for WV and SWIR channels.</p>	

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Agenda Item: 7j Discussion - way forward with Hyperspectral GSICS products – 11:30 (30 minutes)	
Presenter	All
Overview	Likun introduced the discussion topics
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Hyperspectral Inter-comparisons</p> <p>Tom Pagano discussed whether it is really necessary to distribute reprocessed datasets if the differences are negligible - highlighting the different requirements for different applications - especially for climate applications. Bill Bell emphasised the benefit of providing uncertainties with datasets for the reanalysis and the long-term benefits of improving calibration - although ERA will always perform bias correction - knowledge of the uncertainties can be used to bound these.</p> <p>Fred asked about the benefits of comparing double-differences between different agencies (quadruple-difference) to check the transfer.</p> <p>The minimum period necessary to inter-compare hyperspectral sounders was discussed. Although good results are obtainable (e.g. using NWP double-differencing method), these should be checked over an extended period to ensure residuals from the transfer reference do not contaminate the results.</p> <p>A.GIR.2019.7j.1: Likun Wang (NOAA) to check "massive means" method to compare CrIS on S-NPP and NOAA-20.</p> <p>IASI Shortwave Extension was discussed:</p> <ul style="list-style-type: none"> - What are the requirements for this? - Could be used to investigate potential drifts in radiometric or spectral calibration (SRF shifts) <p>Collocation methods</p> <p>Likun suggested the need to review common issues for collocations for different application areas. Tim explained the inter-calibration process can be generalised (non-PICTs based) as:</p> <ul style="list-style-type: none"> • Collect data • Collocate (monitored and reference instruments) • Convert/Convolve (spectra) • Compare (e.g. by regression) • Correct (generate correction function - if necessary) <p>For each application area, GSICS should aim to define a baseline algorithm with relatively simple steps. Further refinements in each of these steps can then be compared with the baseline to improve the algorithm.</p> <p>Use of off-nadir observations was also discussed. It was agreed that there is an ongoing need to ensure that carefully align the viewing angles used in collocations - however, different collocation methods can be used for different application areas.</p>	

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GRWG IR Sub-Group on Multispectral IR Inter-calibration – 7th March, 2019

Chair	Tim Hewison (EUMETSAT)
Minute Taker	Likun Wang (NOAA Affiliate)
Attendance	As above
Remote Attendance	Hui Xu (UMD)

Agenda Item: 7k GEO-LEO IR Product Progress (5 min for each GEO operational agency) – 13:00 (30 minutes)

Presenter	All
Overview	Representatives of JMA, EUMETSAT, NOAA, CNES, JMA and KMA presented the progress of GSICS products for their geostationary imagers' IR channels through the GSICS Procedure for Product Acceptance and recent their developments in this field.

Discussion points, conclusions, Actions, Recommendations, Decisions

JMA (Yusuke): 1) AHI on Himawari-8/-9 using AIRS, IASI, and CrIS intercalibration. 2) re-calibrating IR/WV for GMS to MTSAT-2.

Q (Tim): Who is the plan for the uncertainties table after Masaya?

A: Need to discuss it later.

EUMETSAT (Tim): 1) All SEVIRIs on Meteosat 8, 9, 10, 11 as operational GSICS products 2) generating testing dataset for GEO-ring. 3) Test GSICS Correction impact on Level-2 products; 4) Using IASI-A, -B now and plan CrIS 2021.

NOAA (Fangfang): GOES-16 & -17 ABI for two CrISs (SNPP and N20) and three IASIs (A and B)

Q (Tim): What's NOAA's plans to update GSICS corrections?

A (Fangfang, Mitch, and Fred): No external users. Because the ABI and AHI is so stable in IR channels and this is no need to apply for this.

However, it was recognised that these products would allow valuable comparisons between GSICS agencies, so it was agreed:

A.GIR.2019.7k.1: Fangfang Yu (NOAA) to generate RAC GSICS corrections for GOES-16 and -17 ABI.

CMA (Na Xu): 1) Baseline methodology improves 2) FY4/AGRI with IASI(CrIS/HIRAS) are ready as demo status.

Q (Fred): which IASI? Which CrIS?

A: IASI-A & -B and CrIS/SNPP.

KMA (Minju): 1) IASI-A & -B, CrIS/SNPP, AIRS/Aqua are used; 2) will add N20/CrIS SNO. 3) Prepare for GEO-LEO GK-2A products 3) Collaboration with NOAA on diurnal variation.

ISAO (Tim): INSAT-3D imager and sounders for IASI as demo state.

Comments (Dave D.): check instrument non-linearity.

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Part 2: Switch reference from IASI-A to IASI-B or direct switch to IASI-C.

Comments (Dave D): Discontinuity impacts on products.

Q (Tim): Degradation status for IASI-A? A (Clemence): No new update answer.

Q (Dave D): IASI-C changes in the figure?

A (Clemence): cannot answer because it is still in on-orbit testing, but they are not expected.

[D.GIR.2019.7k.1: All agencies to switch to IASI-B asap as Anchor reference for NRTC and RAC products.](#)

Agenda Item: 7I IR inter-calibration update in CMA including GEO-LEO and LEO-LEO – 13:30 (30 minutes)

Presenter	Na Xu (CMA)
Overview	<p>The talk is about IR inter-calibration update in CMA. She overviewed CMA IR products status. Note that HIRAS products is mainly for research purposes. Two updates on method include 1) collocation 2) spectral fillings. Uniformity check is more important than accurate collocation.</p> <p>She briefed the progress on GEO-LEO inter-calibration and showed some results as well as double differences. She updates diurnal assessment results using CrIS and IASI.</p> <p>She briefed the progress on LEO-LEO inter-calibration, mostly for inter-platform and intra-platform inter-comparison.</p> <p>Na showed :</p> <ul style="list-style-type: none"> ● Collocation methods: No significant impact for GEO-LEO IR windows ● Gap-filling methods: ● Diurnal investigation: using CrIS and IASI SNOs showed no significant effect for FY-4A/AGRI ● Decontamination introduced jump in bias for WV channels ● LEO-LEO: MERSI-HIRAS

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Spatial response function

Q: filtering clear sky results could be helpful for daily results

- Tom Pagano supported this

- Tim pointed need to ensure dynamic range is covered

Q: How to apply LOS collocation method for instruments on different platforms?

- yes applicable

Q: Did compare JMA gap-filling from GEO-LEO IR baseline with new method?

- no because n/a to large gaps

Agenda Item: 7m Collaborative research of applying JMA's GSICS approach to FY-2G IR channels wrt IASI – 14:00 (15 minutes)

Presenter	Yusuke Yogo (JMA)
Overview	<p>This joint venture confirmed an erroneous SRF was previously being used, which gave rise to large differences in some channels. He presented collaboration study between CMA and JAM for FY2 inter-calibration. Conclusion: IR1 and 2 generally agree, but IR 3 still has discrepancy.</p>

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Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Swapping x and y had a big impact on cold scenes - how was weighting assigned when x=GEO?
- No weighting is assigned for y (LEO) in this study.

Q: Contribution to IRRefUTable?
- TBC

A.GIR.2019.7m.1: Yusuke Yogo investigates the weighting regression when switching X and Y.

Agenda Item: 7n Inter-calibration results of COMS/MI using with and without MBCC March 2016 to August 2017 – 14:15 (15 minutes)

Presenter Minju Gu (KMA)

Overview Minju showed the inter-calibration results with and without MBCC, and the key summary are :
1) The IR channels inter-comparison (TB biases) between COMS and LEOs show seasonal variation and diurnal variation
- COMS-AIRS/CrIS whose ECT is 01:30 shows large variation before/after midnight, especially in Spring/Autumn and after eclipse season, in spite of application of Midnight Blackbody Calibration Correction (MBCC)
2) Analysis using L1B with and without application of MBCC(March 2016~August 2017)
- Large discrepancy in biases between with/without MBCC application around midnight in Spring and Autumn, as the erroneous slope increases during the time of the seasons
3) The performance of MBCC in Spring/Autumn is better than Summer/Winter
- The current MBCC performance could be affected to generate products
- Need to analyze the behavior of the MBCC performance/abnormal pattern based on season, eclipse, and so on

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Tim complimented Minju on her clear analysis - especially on Slide 7 box plot over distribution - clearly shows distribution, while allow quantitative assessment of mean and SD.

Comment (Likun): Root cause for the fact that diurnal vibration shows seasonal variation patterns is caused by solar radiation on instrument heating. This is the way for future improvements.

Agenda Item: 7o SBAF requirements for GEO-GEO comparisons – 14:30 (15 minutes)

Presenter Na Xu (CMA)

Overview She talked about SBF requirements for GEO-GEO inter-comparison. Question is what's the next step, given the fact that the SBAF seems to have non-negligible uncertainty?

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Were global IASI data used to derive SBAFs for GEO-GEO?
- No - only GEO domains

Q: Quadratic fits give biases at the ends.
- other forms of fit were suggested - Likun to complete

A.GIR.2019.7o.1: Fred to share conference presentation on ABI GEO-GEO comparisons at a web meeting.

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Q: Write up as a report, including coefficients of the calculated SBAFs ?
- not felt useful

Comment (Likun): Suggests using machine learning techniques.

Comment (Fred): Defining a common spectra response function and all the applications are linked to it.

GSICS do not recommend applying homogenisation to GEO-GEO comparisons for FCDR generation. The algorithms are intended for instrument monitoring.

Agenda Item: 7p GEO-GEO inter-comparison for GOES-17 IR instrument performance monitoring and anomaly detection – 14:45 (15 minutes)

Presenter Fangfang Yu (NOAA Affiliate)

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Could short-term cal-to-cal variations be reduced? e.g. combining E-W space views
-

For daily monitoring, an algorithm may need to select carefully only homogeneous scenes without directional emissivity/BRDF.

Agenda Item: 7q Monitoring SLSTR calibration using IASI – 15:15 (15 minutes)

Presenter Alessandro Burini (EUMETSAT)

Overview He discussed the methods, preliminary results, and future plan for SLSTR inter-calibration using IASI.

Discussion points, conclusions, Actions, Recommendations, Decisions

Q (Wang): 1) why is there a cutoff? 2) Why do you proj4 (slide 9)?

A: 1) saturated 2) It is reversible and recoverable.

Agenda Item: 7r S3 SLSTR IR channel calibration – 15:30 (15 minutes)

Presenter Dave Smith (RAL)

Overview Dave first addressed the traceability of the SLSTR calibration, following the FIDUCEO approach to construct a full uncertainty analysis of the radiometer equation. This is dominated by the thermometry of the black body targets.
He noted that SRF errors looked just like nonlinearity errors.
Tandem phase comparisons showed small differences between S3-A/B in oblique view, which is attributed to residual nonlinearity in the stray light model.

Discussion points, conclusions, Actions, Recommendations, Decisions

Q (Wang): Why the error budget of spectral errors at BB temperature?

A: It is a blackbody target.

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Agenda Item: 7s Discussion Way Forward for Multispectral IR – 16:00 (30 minutes)	
Presenter	All
Overview	<p><u>Collocation:</u></p> <p>Can VIS/NIR ray matching be used for IR also?</p> <p>Spectral Gap filling:</p> <p>Regression?</p> <p>Covered by action on JMA</p> <p><u>GEO-GEO IR baseline algorithm</u></p> <p>Fangfang: we are not there yet.</p> <p><u>LEO-LEO IR baseline algorithm</u></p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
A.GIR.2019.7s.1: Scott Hu (CMA) to propose a demonstration GEO-GEO algorithm through a FY-2 and FY-4 inter-comparison as a demo.	

GRWG IR Sub-Group - Update on IR Research Topics – 7 th March, 2019	
Chair	Likun Wang (NOAA Affiliate)
Minute Taker	Tim Hewison (EUMETSAT)
Attendance	As above
Remote Attendance	Hui Xu, Tony Reale

Agenda Item: 7t Application and evaluation of New NOAA gap filling for CMA IR hyperspectral instruments – 16 :30 (15 minutes)	
Presenter	Hanlie Xu (CMA)
Overview	<p>Hanlie described the application of the gap filling method to MERSI-II.</p> <p>After applying it to CrIS, it was compared to IASI in MERSI channel-space.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: Why is CrIS cooler than IASI at the CrIS spectral gap?</p> <ul style="list-style-type: none"> - Likun suggested it could be caused by performing the comparison over cold polar scenes and that different results may be obtained using global data. - Hui Xu explained that they had made a similar test with CrIS and VIIRS 	

Agenda Item: 7u Investigation to the cold-scene bias at the ABI 3.9 micron channels – 16:45 (15 minutes)	
Presenter	Fangfang Yu (NOAA Affiliate)
Overview	<p>Fangfang's presentation closes an action assigned to her and Masaya to investigate the bias for cold scenes in AHI-IASI comparisons. This was not found in G16/ABI or G17/ABI until the homogeneity filter was relaxed. Not due to radiance-Tb conversion. Looked at the dark side of the Moon to confirm linearity. Fangfang suggested the ABI resampling kernel could introduce cold biases.</p>

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Discussion points, conclusions, Actions, Recommendations, Decisions

Q: How do you treat IASI negative radiances?

- Just included them in the convolution as these are caused by the large noise, which will average out.

Q: Have users complained about the ABI rectification process?

- No - but Fred noticed the problem with cold pixels around fire pixels.

A.GIR.2019.7u.1: Fangfang Yu (NOAA) to work with KMA to apply 3.9 micron cold bias analysis to AMI.

Agenda Item: 7v Sensitivity Test and Further Validation of Cross-track Infrared Sounder Spectral Gap Filling – 17:00 (15 minutes)

Presenter Hui Xu / Likun Wang (UMD)

Overview Hui analysed the impact of changing the training datasets on the gap filling results applied to ABI Channels 7, 8 and 11. He concluded that the results were largely insensitive to this choice, confirming the robustness of the method.

He went on to analyse the scene and scan-angle dependence, which were also very small. However, the largest residuals were found for DCCs. Finally he checked the impact of restricting the training dataset to the ABI domain.

He went on to update on the IASI SW extension, presenting a new method for clear sky ocean scene, which produced good results in these conditions. He plans to go on to develop a training dataset covering more conditions.

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: Training dataset coverage of DCCs? Possible impact of nonlinear extrapolation to v. cold scenes?

Agenda Item: 7w Progress with GRUAN observations in comparison with satellite measurements – 17:15 (15 minutes)

Presenter Bomin Sun (NOAA Affiliate)

Overview Bomin introduced the GRUAN processing for radiosondes, which are intended to act as references with potential application to satellite cal/val. However, there is an ongoing need for GRUAN launches to be synchronised with satellite overpasses in different launch timing configurations.

He presented some initial results, analysing time series of GRUAN sondes in MSU channel radiance-space. These correlated well with MSU observed trends in mid-troposphere, but much less well in the stratosphere. He noted that Calbet et al (2017) performed comparisons with IASI with GRUAN profiles to understand their relative accuracy. Bomin has extended this analysis and suggested RS41 appears to be slightly dry with respect to IASI - though less so than RS92 in the tropics and Lindenberg upper troposphere, but noted the RS41 are not subject to full GRUAN processing yet.

Discussion points, conclusions, Actions, Recommendations, Decisions

Q: What is the uncertainty on the Double Difference of RS92-RS41?

Agenda Item: 7w Near space platform for IR sensor validation – 17:30 (15 minutes)

Presenter Likun Wang (NOAA Affiliate)

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Overview	One of the NOAA Technology Maturity Evaluation projects is to explore the idea of using Google Loon as a platform for remote sensing or in situ sensors. These balloons can stay in the stratosphere for many days and carry a 45kg payload - e.g. cubesat, GPS RO, ... Likun generated collocations with ABI to scope potential for inter-calibration and examined statistics
Discussion points, conclusions, Actions, Recommendations, Decisions	
C: Need to include VZA match up criteria!	

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GRWG UV Sub-Group – 7th March, 2019

Chair	Rosemary Munro (EUMETSAT)
Minute Taker	Sebastien Wagner (EUMETSAT)

Agenda Item: 8a Update on GSICS UV Activities at NOAA – 12 :30 (30 minutes)

Presenter	Larry Flynn (NOAA)
Overview	<p>A summary of the UVSG activities led by NOAA was presented by Larry Flynn. He also highlighted the future opportunities for GEO-LEO inter-calibration which will begin with the launch of the Korean GEMS instrument – a geostationary UV-Vis spectrometer -- and continue with subsequent geostationary AQ sensors. He also noted that the CEOS ACVC has created a plan for CalVal of Geostationary AQ sensors and queried what the GSICS role in inter-calibration could be. This will be a subject for future consideration. Larry also presented NOAA reprocessing of the S-NPP OMPS NM SDR (Level 1) and V8TOz (Level 2) records for the last six years. The associated level 2 monitoring can provide quantitative stability information for the level 1 data and could potentially be transformed into GSICS products by comparing the level 2 products from multiple sensors.</p> <p>NASA has also created soft calibration adjustments for the V8.6Pro algorithm applied to NOAA-16, -17, -18, -19, SBUV/2 and to S-NPP OMPS to create an extension of the Ozone Profile CDR from 2000 to 2018. The inter-instrument soft calibration values could potentially become GSICS products?</p> <p>He noted that because most instruments make solar measurements and use their own spectra to form radiance / irradiance ratios, therefore the main use of the solar spectra is to generate band-passed and solar average radiative transfer model results. They also use a variety of approaches to estimate solar activity variations and wavelength scale stability.</p> <p>Finally, Larry noted that there is activity on-going to provide packaged VLIDORT applications similar to what is provided in other spectral ranges by the Community Radiative Transfer Model.</p>

Discussion points, conclusions, Actions, Recommendations, Decisions

A.GUV.2019.8a.1: UVSG to participate in the planned GSICS Rayleigh calibration meeting, as this is relevant to their planned inter-calibration approaches before GSICS-EP Meeting.

A.GUV.2019.8b.2: Larry Flynn, NOAA, to investigate acquiring Mg II Index and Sun Spot time series as GSICS Deliverables. Due Dec. 2019.

Agenda Item: 8b TSIS-1 spectral (200-2400 nm) solar irradiance observations – 13 :00 (20 minutes)

Presenter	Odele Coddington (LASP, Univ. of Colorado)
Overview	<p>See also 4.h. Odele began by listing the measurements available from a variety of space-based instruments to create composite time series of solar UV irradiance spectra. There are challenges with variations in spectral resolution and coverage.</p> <p>She reported that the new TSIS SIM (Prism Spectrometer) has a better design than the SORCE SIM. The TSIS team performed extensive error breakout analysis. They used NIST Traceable SIRCUS Laser sources and an L-1 cryogenic radiometer to produce an irradiance uncertainty budget of 0.14% of the cryo measurement. Pre-launch validation of the TSIS SIM spectrum to</p>

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	<p>the cryo measurement, full spectrum, was ~0.2% Odele presented comparisons of TSIS SIM spectra with SORCE SIM and SORCE SOLSTICE, ATLAS-3, LASP WHI. TSIS SIM monitor their optical degradation with an additional channel relative to SORCE SIM (i.e. a primary channel, a 2nd channel used ~ weekly to correct the primary, and a 3rd channel exposed ~twice yearly the other channels are corrected too). The TSIS SIM Team are planning to create and release a “Quiet Sun” Spectrum. Initially, a “first light” spectrum will be released (TSIS SIM’s first light was March 2018, which is low solar activity period). One CubeSAT SIM instrument (CSIM) is also now in space and measuring 200-2400 nm, like TSIS SIM; early results show excellent signal to noise and good wavelength registration compared to TSIS SIM but full calibrations have yet to be applied. A CubeSat SOLSTICE (CSOL) instrument has been developed is undergoing further calibrations. When SORCE mission ends (planned for 2019), there will be a gap in full spectrum UV measurements between 100-200 nm. It was noted that GOES-16 (and follow on GOES series) makes a Lyman-alpha irradiance and a Mg II Index measurement. Solar variability models, such as the Naval Research Laboratory models, could be used to estimate the 100-200 nm UV irradiance.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Participation by Odele Coddington (LASP), supporting the spectral solar irradiance discussion, was much appreciated and the productive contact that has been initiated will be continued.</p>	

Agenda Item: 8c Quality Assurance of solar ultraviolet measurements – 13 :20 (20 minutes)	
Presenter	Julian Gröbner (PMOD WRC)
Overview	<p>Julian introduced the main asset of the World Radiation Center which maintains a traveling UV Calibration Reference, the portable Quality Assurance of Spectral UV Measurements in Europe (QASUME). QASUME provides a standard to monitor ground-based solar UV measurements at 1% for simultaneous spectra measurement comparisons. The instrument is traceable to high temperature black body and tunable lasers. The stability is checked with seven lamps maintained at better than 0.2%. The instrument is used to maintain the calibration of approximately 200 ground-based instruments including both simple radiometers and spectrometers. The instrument and an FTS were taken to a mountain top in the Canary Islands, and Langley Plot measurements were made to estimate the top of atmosphere solar irradiance. The FTS results have been compared to Kitt Peak and the QASUME results have been compared to SORCE SIM, ATLAS3, SOLAR_ISS and SCIAMACHY. The team hopes to repeat the Langley Plot measurements and extend the results to the IR. It was also queried whether Brewer measurements had been used and it was clarified that 22 Brewers were brought to a regional intercomparison in Spain. See Link http://www-old.pmodwrc.ch/wcc_uv/wcc_uv.php?topic=qasume_audit for all audits. The Team is also in communication with the NOAA Boulder Team. They performed a reference standard exchange / comparison in 2002, and found agreement at 1%. Direct comparison of spectrometer data is however best.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Participation by Julian Gröbner (PMOD), also supporting the spectral solar irradiance discussion, was much appreciated and the productive contact that has been initiated will be continued.</p>	

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Agenda Item: 8d Current status and future outlook for the UV Sub-group – 13 :40 (20 minutes)	
Presenter	Rosemary Munro (EUMETSAT)
Overview	<p>See also 3.f. Rose provide an outline of the four UVSG projects – comparison and selection of solar reference spectra, development and application of reflectivity channel inter-calibration, development and application of ozone profile channel inter-calibration, and a white paper on ground-based characterization/calibration. She leads the latter project, and requested volunteers to work on topic sections in the outline. The work will be a component for discussion in the planned CEOS WGCV Workshop in 2/2020 – See also 10.b.</p> <p>She then addressed the current scope and interests of the UVSG members. The members of the UV Subgroup typically work with Reflective Solar Spectrometers. These spectrometers may have spectral coverage from the UV to the SWIR. The researchers working with these instruments face similar problems across the spectrum for on-ground calibration and characterization, solar and lunar measurements and trending, inter-calibration approaches, polarization complications, and identifying and using invariant targets and vicarious calibration sites. She proposed changing the UV Subgroup name to reflect this, e.g., to Reflective Solar Spectrometer Subgroup. She also noted that at a joint meeting on Greenhouse Gases, the GSICS UVSG was assigned the Level 1 product CalVal and the CEOS WGCV/ACSG was assigned the Level 2 CalVal.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
See 8e. below.	

Agenda Item: 8e Discussion and Summary – 14 :00 (30 minutes)	
Presenter	Chair - Rosemary Munro (EUMETSAT)
Overview	<p>Overall there was broad agreement for changing the name of the subgroup to reflect the scope of the group better. Dave Crisp noted that there were many similarities with the challenges experienced with UV-Vis spectrometers but also with specific additional challenges such as very high spectral contrast around deep absorption lines. Tom Stone suggested that a distinction be made between the UV and reflective solar parts in the name.</p>
Discussion points, conclusions, Actions, Recommendations, Decisions	
A.GRWG.2019.8e.1: Rose Munro, EUMETSAT, to circulate additional ideas for new subgroup names.	
A.GRWG.2019.8e.2: GRWG Chair to raise the proposal to rename the UVSG to the EP.	

Agenda Item: 8f Calibration needs of space based greenhouse gas instruments – 15 :00 (20 minutes)	
Presenter	David Crisp (NASA/JPL)
Overview	<p>Dave Crisp (NASA) provided an extensive and very interesting overview of the challenges and opportunities in (inter-)calibration of SWIR spectrometers (See presentation). He noted that there were many similarities with the challenges experienced with UV-Vis spectrometers but also with specific additional challenges such as very high spectral contrast around deep absorption lines. He emphasised the value at pre-launch cross-calibration by cross calibrating pre-launch radiometric standards against SI-Traceable standards. This implies sending a person</p>

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with a portable system. The GOSAT and OCO teams learnt things about their own standards by such cross-comparison. Calibration should also be repeated before and after vibration testing and thermal cycling to ensure repeatability. Additionally, the possibility to measure real sun-light while in the thermal vacuum chamber is invaluable. He also noted that the contrast in this spectral region where lines are essentially opaque required an instrument with a very large dynamic range. A large amount of support equipment is also required for the pre-launch calibration e.g. collimator, integrating sphere, step-scan FTS, Heliostat.

He also noted that the resolving power will vary across the bands (which is not the case for an FTS). In order to characterise the instrument line shape (ILS) tunable diode lasers are used. You are working closer to F1.0 or F2.0 with very small optical tolerances.

The ILS characterisation was verified with direct solar observations using a TCCON station very close by. The aim was to achieve agreement to 0.1% across the spectral domain. This is more difficult at low sun because TCCON looks at the centre of the sun but the flight instrument. The on-board calibration system also needs to be calibrated. We need a transfer function between on-ground and in-flight calibration. Routine solar observations are used to track ice build-up on the focal plane arrays, which are periodically heated to get rid of the water. Using lunar calibration, it was possible to diagnose a small pitch error in the spacecraft which was causing problems in XCO₂. Pointing errors $<1/6$ of a footprint can produce biases > 1 ppm where there is rough topography. The lunar disc is slightly polarised and there is a pressing need to characterise this, especially in the SWIR.

Railroad Valley, Nevada is a very important asset for vicarious calibration. There are radiosondes, AERONET observations and autonomous surface meteorological and surface reflectance monitoring systems available. An aircore has never been taken to Railroad Valley. Instead, NASA Ames flies an Alpha Jet in spirals although this misses the upper troposphere. A portable, up-looking EM27-Sun FTS spectrometer is also used to acquire full-column estimates of XCO₂ and XCH₄ during the campaigns. Clemence noted that during the MAGIC campaign there were big differences (a few ppm) between one spiral of the plane and balloon observations with very little time difference. It was noted that knowledge of the BRDF of the valley floor is the principle limit on the uncertainties of the valley floor as a calibration site. These and other factors limit the absolute accuracy to $\sim 3\%$. For OCO-2, the on-board calibration sources are better than this so Railroad Valley observations are basically a cross-check on the on-board calibration. GOSAT however uses Railroad Valley as a primary calibration source for tracking the degradation of its on-board solar calibrator, as they can no longer observe the moon. It was noted that Railroad Valley is under threat by mining, a source of much concern.

Discussion points, conclusions, Actions, Recommendations, Decisions

Space-based systems for measuring GHGs are improving. They complement ground-based data, but will not replace it. There is a need to provide highly accurate data. Well-coordinated constellations of GHG satellites are needed, which must be cross-calibrated and cross-validated. Sentinel-5 Precursor provides new challenges with a 2000-km wide swath. There is a need for better calibration from the sun and the moon, which we can all use. There is also a need to come up with new capabilities for calibration and cross-calibration for these systems to fully exploit them. Clemence mentioned the potential of lidars as a calibration reference. There is also a specific request for solar observations as the solar community has

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difficulty in the O3 band due to strong absorption, which makes it difficult to see solar lines from the ground. Clemence suggested that balloons, used for astrophysics could be useful. These fly at 30-35km and can carry a 500kg instrument. Overall, it was noted that calibration should be acknowledged as a science project. This needs to be emphasised and understood. Sebastian emphasised that we should work with the lunar calibration community and Clemence noted the value of extending the GOSAT and OCO-2 comparison and of making use of existing GSICS tools e.g. the tool for comparing IASI vs CRiS data could be extended ? CNES is considering this.

Overall the importance of pre-launch characterisation was emphasised and this should come out of GSICS.

Agenda Item: 8i Summary and Wrap-up – 17 :40 (20 minutes)

Presenter	Rosemary Munro (EUMETSAT)
Overview	Following an interesting discussion on detailed points it was agreed that the inter-calibration of SWIR spectrometers would be addressed within the UVSG, also taking into account the planned renaming of the UVSG to reflect the de facto scope of the activities better. It was also agreed that GSICS can make a very positive contribution to the inter-calibration of SWIR spectrometers, an area of increasing importance considering the increasing number of GHG missions, in-orbit, in development or planned. The group was also encouraged to raise the importance of (inter-)calibration for this class of instruments in other international fora.

Discussion points, conclusions, Actions, Recommendations, Decisions

R.GUV.2019.8i.1: The group recommends addressing the inter-calibration of SWIR spectrometers within the UVSG (to be renamed - see 8e.).

A.GUV.2019.8i.1: Rose Munro, Eumetsat, to arrange a UVSG web meeting to further discuss specific opportunities and priorities for SWIR spectrometer inter-calibration within the frame of GSICS.

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GDWG – 6 th March, 2019	
Chair	Masaya Takahashi (JMA)
Minute Taker	Peter Miu (EUMETSAT)
Attendance	Jin Woo (KMA), Thomas (CMA), Masaya Takahashi (JMA), Philippe Goryl (ESA), Paolo Castracane (ESA), Toshiyuki Kurino (WMO) & Masaya Takahashi (JMA)
Remote Attendance	ISRO, Alexander Uspensky PT (ROSHYDROMET), Rob Roebling PT (EUMETSAT)

Agenda Item: 6a Round Table Introduction + GDWG Actions Review – 8:30 (30 minutes)	
Presenter	Masaya Takahashi (JMA)
Overview	Masaya summarised the action status.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>GDWG chair firstly welcomed ESA's participation in GDWG breakout session and appreciated their kind consideration on giving three talks relevant to GDWG activities. The chair then reviewed the actions and provided further information on each.</p> <p>A.GDWG.2019.6a.1: CMA to take a lead in bringing the synchronisation script into operations. Once it is done, the script can be rolled out to ISRO and NOAA.</p> <p>R.GDWG.2019.6a.1: GDWG members to allocate time to completing open actions in 2015-2018.</p>	

Agenda Item: 6b New Russian Cal/Val portal on meteorological satellite instruments and products – 9:00 (20 minutes)	
Presenter	Alexander Uspensky (ROSHYDROMET)
Overview	Present the new ROSHYDROMET Cal/Val Website
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Alexander introduced their newly launched website including Landing Page which provides GSICS information to users on well-calibrated products and shows the calibration techniques used. There are GEO-LEO, LEO-LEO and GEO-GEO inter-calibration information.</p> <p>A.GDWG.2019.6b.1: ROSHYDROMET to provide open access to their restricted areas on their website, to be discussed / confirmed in EP meeting.</p>	

Agenda Item: 6c GDWG Baseline Reviews - website, products metadata and structures – 9:20 (30 minutes)	
Presenter	Jin Woo (KMA)
Overview	Annual Review of the GSICS websites
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>The presentation provides the criteria for the common content for the GPRC GSICS websites. Note: GPRC websites no longer need to refer among other, up-to-date links are now kept on the WMO website.</p> <p>R.GDWG.2019.6c.1: All GPRC website, Wiki and WMO administrators are requested to refer to the presentation (6c_GDWG_Baseline_Reviews_2019_KMA_jwoo.pptx) to update their websites.</p> <p>A.GDWG.2019.6c.1: ESA to consider preparing a GSICS website. If possible, present in the next GSICS Annual meeting / web meeting. (Minimal contents for GSICS Website is noted on the Wiki, this content may be</p>	

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updated for ESA's case)

The group clarified how the GSICS members are proposed, this is done by the organisation EP members.

A.GDWG.2019.6c.2: GDWG Vice Chair (Pete) to check if the procedure for GSICS member nomination is documented in the ToR and update if not.

Note: The selection of Chair and Vice Chair is proposed by the working groups, and this requires endorsement by the EP. This is documented in the GSICS Terms of Reference ([ToR](#)).

Agenda Item: 6d New WMO GSICS Portal – 09:50 (40 minutes)

Presenter	Toshiyuki Kurino (WMO)
Overview	Presents the WMO website & new user update functionality
Discussion points, conclusions, Actions, Recommendations, Decisions	
Toshiyuki introduced a new GSICS WMO Portal, which is located at WMO “Extranet” domain. The new website is launched in 2018 and the “look and feel” policy was shortly demonstrated. A user login has been implemented in the website to allow people outside WMO to update of the site contents. Such accounts are proposed to provide to GSICS members. Questions were raised regarding update activity logging and security concerns, but these are currently unknown. It was also pointed that the user manual is expected to be shared with GSICS members in the near future.	
A.GDWG.2019.6d.1: WMO to provide GDWG Chair with user manual for updating the WMO GSICS Portal and an account to familiarise with the system.	
A.GDWG.2019.6d.2: GDWG Chair to propose how WMO GSICS Portal accounts are used based on the functionality implemented (updating logging, security concerns). The proposal is to be presented to GSICS EP for endorsement and documented in the ToR.	

Agenda Item: 6e GSICS Convention for Spectral Response Function files – 11:00 (20 minutes)

Presenter	Masaya Takahashi (JMA)
Overview	Introduction to backgrounds on developing GSICS SRF Convention and current status of GSICS SRF Convention and discuss future updates.
Discussion points, conclusions, Actions, Recommendations, Decisions	
Masaya introduced the requirements of generating SRF netCDF files for GSICS activities (e.g. GIRO for lunar calibration) and discussion in 2018 via gsics-dev in order to standardize the file naming and netCDF Conventions. In the plenary, some members expressed that the WMO file naming convention is not easy for the use. The group agreed such an opinion but in the context of GSICS applications, the recommendation is to follow the proposed WMO filename convention and Spectral Response netCDF Convention.	
A.GDWG.2019.6e.1: GDWG Chair to report GDWG recommendation on GSICS SRF Conventions to EP for the endorsement and propose the update in ToR with this recommendation.	
A.GDWG.2019.6e.2: WMO to provide a procedure for updating the Common Table C-13 of the WMO Manual on Codes to the GDWG Chair so that an addition of “SRF” string to the table can be performed.	
A.GDWG.2019.6e.3: GDWG Chair to coordinate the proposed update to the Common Table C-13 of the WMO Manual on Codes (i.e. adding “SRF” string to the Data Designator table).	

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Agenda Item: 6f How EUMETSAT's pathfinder activities would benefit GSICS – 11:00 (40 minutes)	
Presenter	Peter Miu (EUMETSAT)
Overview	Information presentation on future data access/delivery/visualization/customisation/processing at EUMETSAT
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Peter introduced EUMETSAT's PathFinder activity, which is their future data services to be fully operational in 2020. There are several new features. One of them is that processing nodes on EUMETSAT server is assignable for the use by users. The other is EUMETSAT Product Customisation Toolbox (EPCT) which customise reformats the products.</p> <p>Similar developments are being implemented at ESA (see agenda item 6i). Sharing knowledge on these activities would be beneficial to the organisations and GSICS. For example, online data access (OLDA) could be used as a GSICS products' access service and be processed on a host processing node to generate the products. The group was very interested in how to specify the requirements for these pathfinders as it is difficult to anticipate what the users need.</p>	

Agenda Item: 6h CEOS Working Group on Information Systems and Services (WGISS) – 14:00 (30 minutes)	
Presenter	Mirko Albani (ESA)
Overview	Information presentation on CEOS Working Group on Information Systems and Services (WGISS)
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Mirko Albani, who is the current chair of WGISS introduced their activity. WGISS promotes collaboration in the development of information systems and services that manage and supply EO data/products and develop prototypes supporting CEOS and EO data.</p> <p>There was interest in the group for the WGISS EO Stewardship, Maturity Matrix - Similar to the GPPA. WGISS Connected Data Assets (CDA) - single entry point for external clients to discover and access CEOS agencies data. WGISS appreciates EUMETSAT's participation and hope this participation to continue in the future. The group agreed that GDWG could explore sharing development resources with WGISS.</p>	

Agenda Item: 6i ESA Collaborative Environment for Cal/Val – 14:30 (30 minutes)	
Presenter	Andrea Della Vecchia / Damiano Guerrucci (ESA)
Overview	Information presentation on ESA's Data access services and platforms promoting collaboration between various working groups and users.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Andrea introduced Collaborative Environment for Cal/Val at ESA. He firstly pointed that the collaborative environment aims to change the paradigm from "data to user" to "user to data". Then he showed some examples of current Collaborative Environments: Thematic Exploitation Platform, Mission Exploitation Platform for Proba-V, and Joint ESA-NASA Multi-Mission Analysis Platform for the transparent access to the content of both platforms.</p> <p>He also introduced Payload Data Ground Segment (PDGS) at ESA, which provides a set of interoperable and</p>	

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federated services permitting the users (e.g. data discovery, direct download of EO and in-situ data, hosted processing for authorised users/communities on Jupyter notebook). The services are similar to those being developed in the EUMETSAT PathFinders and the group showed strong interests on their activities.

Agenda Item: 6j Event Logging – 15:00 (30 minutes)

Presenter	Rob Roebeling (EUMETSAT)
Overview	Report of status on landing pages, proposal for update to WMO OSCAR, and discussion on how to proceed with the next step proposed for calibration event logging.

Discussion points, conclusions, Actions, Recommendations, Decisions

Rob provided a status on landing pages with a great appreciation to ROSHYDROMET's launch of the page in 2018. Then he proposed actions to GDWG and the group discussed how to progress with this activity. The first point was which entity could be responsibility for maintaining satellites/instruments Landing Pages that can be linked to/from WMO OSCAR/Space. Rob has annually updated the list of Landing Pages and informed that to WMO as a lead of Calibration Event Logging Task Team. Masaya proposed that GDWG Chair may take over the role including the communication with agencies who have yet to prepare the pages.

A.GDWG.2019.6j.1: GDWG Chair to propose GSICS-EP the entity responsible for maintaining satellites/instruments Landing Pages.

The second point was an adoption of common nomenclature/standards of the event logging, which was proposed by CGMS white paper (CGMS-45-EUM-WP-33). At 2018 GRWG/GDWG Annual Meeting, the Task Team recommended CGMS to establish a Technical Team on Event Logging due to a difficulty of accomplishing the goal under the current Task Team.

Rob pointed that his task on this topic is completed as the White Paper was submitted to CGMS. GDWG is invited to discuss if the group can support progressing in this task. It was reported by GDWG Chair at 2018 GSICS-EP-19 for further discussion with CGMS, but the progress is not clear. Masaya commented that this issue will be reported again at GSICS-EP-20.

A.GDWG.2019.6j.2: GDWG Chair to report GSICS-EP a recommendation of Event Logging Task Team to establish a Technical Team for further discussions at CGMS meetings.

Agenda Item: 6k GOES-16/-17 ABI Calibration Event Log –15:30 (20 minutes)

Presenter	Xiangqian (Fred) Wu (NOAA)
Overview	Fred Wu introduced the design considerations and status of Calibration Event Log for GOES ABI.

Discussion points, conclusions, Actions, Recommendations, Decisions

The event logging webpages contain the information on 1) Calibration 2) Event and 3) Log. The system covers actual/potential impacts on calibration such as incorrect gain and scan mode change including the duration. It was presented that non-calibration events such as a data gap is not covered in this logging system. The logging has been maintained by the GOES-R Calibration Working Group who has the discretion of what to log.

Masaya suggested to alert users whenever the Calibration Event Logging is updated. He also agreed to

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exclude the events not related to calibration, such as data missing, but suggested to link to such source of information. Fred thanked Masaya and agreed to consider.

A.GDWG.2019.6k.1: Fred Wu (NOAA) to consider alerting users of Calibration Event Log update.

A.GDWG.2019.6k.2: Fred Wu (NOAA) to consider linking Calibration Event Log to notifications of expected events such as the information provided by OSPO.

Agenda Item: 6l FY historical Big Data Reprocessing system establishment and sharing – 16:50 (30 minutes)

Presenter Zhe (Thomas) Xu / Di Xian (CMA)

Overview Information Presentation: retrospective recalibration of historical Chinese EO satellite data.

Discussion points, conclusions, Actions, Recommendations, Decisions

Reprocessing of Chinese historical satellite data is underway as Phase B (2018-2022) of projects on Space-based Radiometric Benchmark. FY (FY-1, 2, 3 of L1, OLR, SST, etc.), HY, and ZY satellites data are reprocessed at CMA by using Big Data technology (not Hadoop). GPU is used for L2 reprocessing.

Agenda Item: 6m Links from WMO OSCAR/Space to Calibration Landing Page – 16:50 (30 minutes)

Presenter Toshiyuki Kurino

Overview Discussion how to improve accessibility

Discussion points, conclusions, Actions, Recommendations, Decisions

Toshiyuki introduced users' feedback that NWP community requires one-stop shopping to the instrument events (monitoring) page in case of any anomalies of satellites/instruments, and the current OSCAR/Space is difficult to navigate. For instance, there are so many links to click and it is not easy to find the landing pages. It is also confusing that there are the same URLs in texts (e.g. SEVIRI has several links that look the same: www.eumetsat.int) even though the latter implementation was due to development restrictions in OSCAR/Space. The group reviewed WMO's minor updates (e.g. adding "G" (GSICS) logo at the left of links to monitoring pages). The group commented that we need further interactions with users in order to realize useful links/navigations on OSCAR/Space.

R.GDWG.2019.6m.1: WMO to consider the redesigning OSCAR/Space instrument pages (e.g. links to Landing Pages and instrument monitoring pages).

Agenda Item: 6n Use of GitHub - updates – 17:20 (30 minutes)

Presenter Jin Woo (KMA)

Overview Status of the use of GitHub for GDWG activities

Discussion points, conclusions, Actions, Recommendations, Decisions

In January 2019, GitHub can restrict access to the repository to 3 collaborators. Previously, this was a paid option. KMA has used GitHub to build the GSICS Plotting Tool on KMA internal server. This almost works but there are some issues with the structure of the THREDDS catalogue which is used as a data source for the tool. This will be further discussed in the ISRO related presentation.

A.GDWG.2019.6n.1: GDWG chair to create GDWG GitHub repository link on GSICS Wiki.

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GDWG – 7 th March, 2019	
Chair	Masaya Takahashi (JMA)
Minute Taker	Peter Miu (EUMETSAT)
Attendance	Jin Woo (KMA), Zhe Xu - Thomas (CMA), Peter Miu (EUMETSAT), Shergli Wu (CMA), Bruno Picard PT (ESA), Jerome Bouffard (ESA), Paolo Castracane (ESA), Toshiyuki Kurino PT (WMO), Manik Bali PT (NOAA-Affl) & Masaya Takahashi (JMA)
Remote Attendance	Nitant Dube PT (ISRO)

Agenda Item: 9a GSICS Collaboration Servers - History, Updates – 8:30 (20 minutes)	
Presenter	Peter Miu (EUMETSAT)
Overview	Overview and clarification of the servers and the data sets relevant for other collaboration server presentations.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Peter provided a history of GSICS Collaboration Servers, datasets stored/preserved in the servers and Plotting Tool. He also briefly introduced GPPA, which is an important process for GSICS Products' validation. The group discussed a usage of netCDF Enhanced Data Model such as grouping function for future products even though the use of Classic NetCDF-4 was recommended by GDWG. It was agreed that Enhanced Data Model is useful for big/complicated dataset. The current GSICS products are no need to use the model, but may be re-considered in future if it is really required by GRWG.</p>	

Agenda Item: 9b Status of THREDDS for GSICS Collaboration Servers – 8:50 (40 minutes)	
Presenter	Nitant Dube (ISRO)
Overview	Report on the current statuses of THREDDS and Plotting Tool at ISRO
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Nitant demonstrated the ISRO GSICS website and their Plotting Tool. The plotting tool can plotting anything from a collaboration server; NRTC and RAC products. Both systems are still under developments. ISRO kindly offers the sharing of their developments for members of GSICS.</p> <p>A.GDWG.2019.9b.1: ISRO to work with KMA to upload their Plotting Tool code and configuration onto GDWG GitHub repository.</p> <p>A.GDWG.2019.9b.2: ISRO to work with CMA to synchronise their RAC products between their servers to validate the synchronisation scripts.</p> <p>A.GDWG.2019.9b.3: ISRO with support from EUMETSAT to update their THREDDS configuration such that it is in-line with the other collaboration services.</p>	

Agenda Item: 9c Updates on GSICS Collaboration Servers – 9:30 (20 minutes)	
Presenter	Zhe (Thomas) Xu (CMA)
Overview	Report on the current status of GSICS Collaboration Server at CMA
Discussion points, conclusions, Actions, Recommendations, Decisions	

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CMA has 2 real time products on their server and synchronise using CMA code. This will be updated to use an enhanced version developed by EUMETSAT based on the existing CMA code as these supports improved automation and is documented.

CMA will take the lead in the synchronisation activity between the collaboration servers.

Note: As agreed with the GDWG members (and the EP was informed in the Biot meeting), only the RAC operational products are synchronised between the collaboration servers.

CMA demonstrated their new FY4 data access service; these data sets could be used as source data sets for calibration products.

A.GDWG.2019.9c.1: Peter Miu (EUMETSAT) to upload products synchronisation script to GitHub.

A.GDWG.2019.9c.2: Zhe Xu (CMA) and Peter Miu (EUMETSAT) to work on preparing a version of CMA source data down script for the users.

R.GRWG.2019.9b.1: CMA is encouraged to submit their existing calibration products to GPPA.

Agenda Item: 9d Updates on GSICS Collaboration Servers – 9:50 (20 minutes)

Presenter Manik Bali (NOAA Affiliate)

Overview Report on the current status of GSICS Collaboration Server at NOAA

Discussion points, conclusions, Actions, Recommendations, Decisions

Manik informed the group that the NOAA server has been down for some time, and this has now been brought up again but need to be updated to reflect the directory structure of the other collaboration servers.

A.GDWG.2019.9d.1: NOAA to reconfigure their GSICS server to following the THREDDS structure as agreed by the GDWG members (see: <http://gsics.eumetsat.int/thredds/catalog.html>, <http://gsics.nsmc.org.cn/thredds/cmaProducts.html>, <http://gsics.nsmc.org.cn/thredds/isroProducts.html>)

A.GDWG.2019.9d.2: NOAA to check the links on the WMO website. See: <https://gsics.wmo.int/en/product-services-and-technical-information>

NOAA has provided a FTP script to download GSICS data and products from other GSICS servers. This has been tested by downloading all the data sets from the EUMETSAT GSICS server. A suggestion was made to offer these downloaded data sets from a FTP server to users. The GDWG members agreed that GSICS products shall only be accessible from GSICS collaboration servers as offering the GSICS products from other data access service(s) would cause users' confusion as well as maintenance concerns as the tools working of the data from the THREDDS servers will not work with the proposal.

Agenda Item: 9e PICS/SNO data extraction function – 10:40 (20 minutes)

Presenter Lin Chen (CMA)

Overview Proposal on sharing PICS L1 and SNO prediction data on GSICS Collaboration Servers.

Discussion points, conclusions, Actions, Recommendations, Decisions

Lin proposed sharing PICS L1 data sets and SNO prediction information by introducing how the PICS/SNO data are extracted/predicted. The data set could be provided as a source data set from the GSICS collaboration server for the development of GSICS products. CMA express a desire for GSICS source data

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providers to provide reduced LEO data sets for LEO inter-calibration. This can be done using a tool they have developed to pre-determine the cross over orbit passes for LEO satellites. The group discussed if the over pass information is useful for GSICS and for GRPC users and it seems this information is useful.

Lin displayed the PICS filename and requested support in bringing the filename towards the WMO filename standard used by GSICS. The filename convention used by GSICS is provided here:

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

A suggested filename format could be something like:

pflag_productidentifier_oflag_originator_yyyyMMddhhmmss[_freeformat].type[.compression]

W_CA-CMA-Beijing,XXX+YYY,FY+INST_C_FYD_YYYYMMDDHHMMSS.nc

A.GRWG.2019.9e.1: Lin Chen (CMA) and Sebastien Wagner (EUMETSAT) to specify user requirements and use cases on Level-1 data subsets over PICS and SNO prediction, and present it to GRWG in order to see if this is useful for the supporting GPRC organisations.

Agenda Item: 9f Data Dissemination – 11:00 (20 minutes)

Presenter Lin Chen (CMA)

Discussion points, conclusions, Actions, Recommendations, Decisions

Discussed in 9e.

Agenda Item: 9g Visualization of GSICS Products on GSICS Plotting Tool - Current Status and User Requirements – 11:20 (20 minutes)

Presenter Masaya Takahashi (JMA)

Overview Introduction to GSICS Plotting Tool, GRWG requirements and recent GDWG activities on the Plotting Tool in order to discuss what GDWG can do in future.

Discussion points, conclusions, Actions, Recommendations, Decisions

No updates to the current systems, GSICS guidelines, conventions, standards will be discussed in the future when needed.

Agenda Item: 9i Discussion for future updates/collaboration on GSICS Collaboration Servers and Plotting Tool – 11:40 (20 minutes)

Presenter All

Discussion points, conclusions, Actions, Recommendations, Decisions

Discussed in previous agenda items

Agenda Item: 9j Visualization of GSICS Products on GSICS Product Catalog and GSICS Wiki Migration – 14:30 (30 minutes)

Presenter Manik Bali (NOAA Affiliate)

Overview Proposal on GSICS Wiki migration

Discussion points, conclusions, Actions, Recommendations, Decisions

The Wiki has to be moved to another server location. The Wiki is an essential resource for GSICS so the options for performing this task are required to be considered with a view to reduce the risk of another move in the future.

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A.GDWG.2019.9k.1: GCC to present the options available for the Wiki migration to the GDWG members, and coordinate a way forward to present to the GSICS EP.

Agenda Item: 9k Action Tracking – 14:00 (minutes)	
Presenter	Manik Bali (NOAA Affiliate)
Overview	Information presentation on the current functions of GSICS Action Tracker
Discussion points, conclusions, Actions, Recommendations, Decisions	
Manik introduced the Action Tracker. It was agreed that the group's recommendation on the updates of Action Tracker at GDWG Web meeting in January 2019 and no new requirements were requested.	
A.GDWG.2019.9l.1: GDWG Chair to provide GCC the updates for GSICS Action Tracker which was agreed at GDWG Web meeting in January 2019.	

Agenda Item: 9l Introduction to EVDC (ESA Atmospheric Validation Data Centre) – 14:00 (20 minutes)	
Presenter	Paolo Castracane (ESA)
Overview	Information presentation on EVDC
Discussion points, conclusions, Actions, Recommendations, Decisions	
EVDC serves as a long-term repository for archiving/exchanging correlative data for validation of atmospheric composition products from satellites: https://evdc.esa.int . It currently focuses on Sentinel-5P and Aeolus and provides tools for Cal/Val data conversion/upload/query/download, Satellite orbit prediction. EVDC also provides access to satellite data subset for specific missions over user defined areas. Tools are very applicable to GSICS activities and Sentinel-5P data available via EVDC is currently under-implementation. GDWG members are invited to look at the presentation with a view of if they can be used in GSICS.	

Agenda Item: 9m Automated validation tool for candidate GSICS products – 15:30 (30 minutes)	
Presenter	Peter Miu (EUMETSAT)
Overview	Study of automated validation tool applicable in GPPA
Discussion points, conclusions, Actions, Recommendations, Decisions	
GDWG chair requested a study for improving the speed of progress through the GPPA. User requirements and design was presented to the group for an automated system to prompt GPAT and product producers to pay attention to the GPPA. The purpose of this system is to speed up the progress of the GPPA, and minimise the learning of new members of the GPAT.	
The GDWG discussed whether such a tool is needed. The consensus was mixed, and the GCC deputy director felt that everything was already in place and no need for this system.	
Thoughts on this system are available should it be required in the future.	

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Agenda Item: 9n Splitting user feedbacks into GRWG/GDWG actions – 16:00 (30 minutes)	
Presenter	Masaya Takahashi (JMA) and Manik Bali (NOAA Affiliate)
Overview	Discussion on splitting Ken Knapp's comments on THREDDS and GSICS Products (agenda item 3l) into GRWG/GDWG actions.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>At Day-2 Plenary (agenda item 3l), Ken Knapp submitted some observations on the THREDDS server usage and products' contents. These were discussed in the GDWG to see what improvements can be considered. The points of discussion are addressed by the following actions.</p> <p>A.GDWG.2019.9p.1: Peter Miu (EUMETSAT) to provide a user guide for using the THREDDS system.</p> <p>A.GDWG.2019.9p.2: GCC to provide EUMETSAT the download script for review to see if this can be provided to users to improve the downloading of GSICS products.</p> <p>A.GRWG.2019.9p.3: GRWG Chair to consider improving the GSICS inter-calibration coefficients because they are difficult for the user to apply these corrections.</p> <p>A.GDWG.2019.9p.4: GCC to contact Ken Knapp to what website he is referring to regarding his comment that it is for contributors and not users, and report this to the working group.</p> <p>A.GDWG.2019.9p.5: GCC to confirm with the GRWG to release the next version of the product catalogue to address table concern from Ken.</p>	
Agenda Item: 9o Wrap-up: Plan activities for 2019/2020 – 16:00 (30 minutes)	
Presenter	Masaya Takahashi (JMA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>The group reviewed actions and recommendations proposed during the breakout session. It was also agreed to hold two web meetings (THREDDS/Plotting tool in summer 2019 and a progress meeting in Jan 2020). Masaya commented that he will have to leave GSICS in 2019 and the nomination of new GDWG Chair is underway with a support of GSICS-EP Chairs and Vice-Chairs.</p>	

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Plenary on GRWG/GDWG Cross-cutting Topics– 8 th March, 2019	
Chair	Larry Flynn (NOAA)
Minute Taker	Fangfang Yu (NOAA)

Agenda Item: 10a GSICS Requirements on Instrument Performance Monitoring – 8:30 (20 minutes)	
Presenter	Dohyeong Kim (KMA)
Overview	Dohyeong introduced the EP-18.01 Action and AGRWG.2018.10b.1, and reported the information on the specifications and methodologies of instrument performance monitoring systems received from each agency. He pointed out that EP wants the minimum information for the calibration. But it was not discussed in detail in the last EP meeting.
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Q: (Fred) what is the long-term vision of this monitoring? Homogenous plots/formats. Any plan to the goal?</p> <p>Mitch: More in EP meeting. Need to be structured with minimum set of monitoring. Not deep-dive ones. More detailed information in each agency.</p> <p>Tim: related to instrument landing page?</p> <p>Fred: Landing page is static. This can be linked to the landing. AHI webpage is an example.</p> <p>Ed: Who is the audience? How do we know about the audience?</p> <p>A.GEP.2019.10a.1: Mitch Goldberg (NOAA) to prepare a white paper specifying how to find the users and identify users' need/request.</p>	

Agenda Item: 10b Preparation for forthcoming meetings (e.g. SI-traceable Reference Instrument WS, Lunar Calibration WS) – 8:50 (20 minutes)	
Presenter	Xiuqing (Scott) Hu (CMA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Scott talked about the coming workshops.</p> <ul style="list-style-type: none"> ● GSICS workshop in the joint EUMETSAT/NOAA/AMS meeting in Boston. <ul style="list-style-type: none"> ○ No GSICS workshop ● 3rd lunar calibration workshop: time/location TBD. Probably at the end of 2019 or early 2020. Tom Stone commented that new measurement such as air-LUSI can help to constrain the uncertainty of the lunar irradiance models and it should be added as an objective in the workshop. <p>A.GRWG.2019.10b.1: Scott Hu (CMA) to add one more objective in the lunar workshop that new measure (e.g. air-LUSI) can constrain the uncertainty of the lunar irradiance models.</p> <ul style="list-style-type: none"> ● SI-traceable Space-based Climate Observing System workshop: Sept 9-11, 2019 at NPL, UK, sponsored by CEOS and GSICS - covers CLARREO-like instruments. ● CEOS/GSICS optical space instrument on pre-launch calibration workshop is postponed to 2020. Scope of the workshop is agreed. Location will be in Europe. ● Re-calibration/Re-processing workshop is a potential activity that could be tied to the 2020 GRWG meeting. 	

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Mitch: focus on “best” practices involved.

Tim: promote the GSICS role in the re-processing by focusing on “inter-calibration”.

Fred: need to know the cause of the inter-calibration difference.

A.GEP.2019.10b.2: Mitch Goldberg (NOAA) to talk about these meeting/workshop in the coming EP meeting.

A.GRWG.2019.10b.3: Scott Hu (CMA) to incorporate the comments and suggestions from the annual meeting in the report of the potential re-calibration/re-processing workshop to the EP.

Agenda Item: 10I CLARREO Pathfinder - Updates – 10:20 (20 minutes)

Presenter Dave Doelling (NASA)

Discussion points, conclusions, Actions, Recommendations, Decisions

Two SI-traceable calibration and inter-calibration demonstration purposes. It is now scheduled to be launched in 2023 on ISS. LASP optical design and scan patterns. CPF/CERES and CPF/VIIRS inter-calibration algorithm sequences are presented. Achievements include the predictions of SNO events for VIIRS, and inter-calibration opportunity for the GEO satellites.

Tom Stone: there is a lunar inter-calibration working sub-group inside the inter-calibration group.

Agenda Item: 10d How to update actions in GSICS Action Tracker – 10:40 (20 minutes)

Presenter Manik Bali (NOAA Affiliate)

Discussion points, conclusions, Actions, Recommendations, Decisions

Manik showed that GSICS Actions Tracker Live Demo. The actions were previously monitored on the GSICS wiki page. The new tracker system has a faster search function. It uses Google Cloud sheets and displays in the web. Plan to use this new tracker to present the actions to the coming EP meeting. Need to use the ID format to create the actions.

Question (Tim): Using Google to communicate with China is problematic.

A: A workaround procedure is being developed.

Agenda Item: 10e Mission-Integration Calibration Monitoring & Inter-Calibration System (MICMICS) – 11:00 (20 minutes)

Presenter Sebastien Wagner (EUMETSAT)

Discussion points, conclusions, Actions, Recommendations, Decisions

The goal of MICMICS is to integrate and develop further the tools for monitoring the radiometric calibration of the current and future missions operated by EUMETSAT. Some components of MICMICS can also be used to serve as the contributions of EUMETSAT to GSICS. Scopes, developments timeline and current status are introduced. The components that will be of interest for GSICS are outlined.

Tom Stone: Is this an internal system?

A: It is an internal operational system, but the reports will be also publicly accessible.

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Plenary on De-briefs and Wrap-up – 8 th March, 2019	
Chair	Xiuqing (Scott) Hu (CMA)
Minute Taker	Tim Hewison (EUMETSAT)

Agenda Item: 10h GDWG Summary & Agree Actions – 11:50 (20 minutes)	
Presenter	Masaya Takahashi (JMA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
Masaya reported GDWG discussions and actions/recommendations reviewed at GDWG breakout session.	

Agenda Item: 10i GRWG Summary & Agree Actions – 12:10 (30 minutes)	
Presenter	Xiuqing (Scott) Hu (CMA)
Discussion points, conclusions, Actions, Recommendations, Decisions	
<p>Agreed the draft actions, recommendations and decisions with the following changes:</p> <p>R.GIR.2019.3d.2 - remove this!</p> <p>A.GRWG.2019.3m.1 - Action Srirish</p> <p>A.GRWG.2019.2n.1 - Action Bill Bell</p> <p>A.GMW.2019.3o.1 - clarify action - add chair</p> <p>A.GRWG.2019.3p.1 - remove Goal:...</p> <p>A.GVN.2019. - add 3 actions from Seb on Lunar Calibration:</p> <p>Add action on Dave to org web meeting on DCC paper</p> <p>MWSG - summary notes need tidying up!</p> <p>A.GMW.2019.3o.1 - needs clarification</p> <p>A.GMW.2019.5m.1 - check with Bomin</p> <p>A.GMW.2019.5m.1 - add ATBD - and renumber actions</p> <p>A.GMW.2019.5o.1 - remove "will"</p> <p>A.GMW.2019.5x.1 - to be combined in A.GWG.2019.5t.1 - and renamed A.GMW.2019.5x.1</p> <p>A.GIR.2019.7f.1 - to add MERSI and AGRI</p> <p>A.GIR.2019.7i.1 - Change Minu to Minju and renumber</p> <p>A.GIR.2019.7j.2 - remove</p> <p>A.GIR.2019.7k.1 - tidy up</p> <p>R.GIR.2019.7k.1 - for all agencies</p> <p>A.GIR.2019.7k.2 - for baseline method for AHI-IASI/CrIS</p> <p>A.GIR.2019.7s.2 - change baseline to demonstrate</p> <p>A.GIR.2019.7u.2 - remove</p> <p>A.GIR.2019.7v.1 - remove</p> <p>A.GUV.2019.8b.1 - add "before EP meeting"</p> <p>Q: Request agencies to provide GSICS Product development plan? Seb stressed that if we don't generate products,</p> <ul style="list-style-type: none"> - Masaya agreed - Mitch explained that the EP usually request proposals - Fred explained NOAA do not generate GSICS products as there has been no user requirement - Mitch emphasised the importance of all GPRCs providing comparable monitoring for their instruments. 	

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A.GRWG.2019.10g.1: GRWG chair to request GPRCs to present plans to develop GSICS products at 2020 annual meeting and include in template for Agency Reports.

A.GWG.2019.10g.2: Mitch Goldberg (NOAA) to discuss the need for uniform GSICS monitoring pages at the Executive Panel.

Agenda Item: 10j Future GSICS Users Workshops – 12:40 (20 minutes)

Presenter	Larry Flynn (NOAA)
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Discussion points, conclusions, Actions, Recommendations, Decisions

Proposal to host GSICS User Workshop at ITSC-22 Quebec 31 Oct to 6 Nov 2019 was discussed with one ITSC chair (Liam). Mitch emphasised that ITSC represents the main users of radiances and warned that they are interested in the details of the science.

Tom suggested a report on GSICS activities could be included in the MW or IR calibration.

Mitch suggested that this could be followed up in an evening session.

GCC will coordinate and work with EP to identify GSICS representatives.

Agenda Item: 10k Topics & Chairing next Web Meetings – 13:00 (20 minutes)

Presenter	All
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Discussion points, conclusions, Actions, Recommendations, Decisions

The proposed list of web meetings was agreed with the following exceptions:

- Remove sites for CLARREO pathfinder
- Add D. Doelling to lead a web meeting on Solar Spectra
- Add Seb to lunar calibration web meeting
- GEO-GEO to be led by Fangfang in June
- Add GDWG web meetings
- Add GUW preparation web meeting - 2-3 months before ITSC

The resulting list of web meetings expected for the next 12 months is:

2019	Dave Doelling	Solar Spectra
2019-01	GDWG	Progress meeting
2019-??	Sebastien Wagner	PICS sites data extraction and sharing
2019-??	Tim Hewison	IR Reference Uncertainty and Traceability - "IRRefUTable"
2019-??	Fangfang Yu	GEO-GEO inter-comparison algorithms
2019-??	Ralph /Qifeng Fu	Microwave subgroup - multiple meetings
2019-??	Tim/Rob Roebeling	Reprocessing/Recalibration Workshop planning
2019-04	Tom Stone	3 rd lunar calibration workshop planning

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2019-??	GIR - L. Wang	Hyperspectral sounder inter-comparison
2019-??	GVNIR - D. Doelling	Extension of DCC method to NIR
2019-07	GDWG	THREDDS/Plotting Tool
2019-06	GCC – L. Flynn	Webmeeting for user workshop preparation
Late	GUV - R. Munro	Ultraviolet Sub-Group web meeting
Late	GIR - T. Hewison	Review GEO-LEO IR inter-calibration algorithm evolutions
Late	GRWG - X. Wu	MTF characterization on the moon
Late	GVNIR - D. Doelling	Plan journal paper on DCC method
Late	GVNIR - B. Fougnie	Rayleigh scattering calibration

Agenda Item: 10l Date & Place of Next WG Meetings – 13:20 (20 minutes)

Presenter	All
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Discussion points, conclusions, Actions, Recommendations, Decisions

Scott proposed the 2020 meeting be hosted in Asia or US.

Fred proposed to return to Korea in 2020. Dohyeong Kim graciously accepted to consider this.

A.GWG.2019.10l.1: Dohyeong Kim (KMA) to plan to host GRWG/GDWG meeting in March 2020.

A.GWG.2019.10l.2: Odele Coddington (LASP) to consider hosting GRWG/GDWG in 2021.

Agenda Item: 10m Any other business – 13:40 (20 minutes)

Presenter	All
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Discussion points, conclusions, Actions, Recommendations, Decisions

The group expressed their thanks for the hosting and hospitality provided by ESA.

Minutes of the 2019 Annual GSICS Joint Working Groups Meeting

Participants list (including remote participants) - 2019 GRWG/GDWG Annual Meeting

Acri-st	Nicolas	Lamquin	ESA	Alessandro	Piro
CIMSS	Liam	Gumley	ESA	Christian	Retscher
CMA	Lin	Chen	ESA	Lidia Saavedra De	Miguel
CMA	Qiang	Guo	ESA	Roberto	Sabia
CMA	Xiuqing	Hu	ESA	Silvia	Scifoni
CMA	Qifeng	Lu	ESA	Mirko	Albani
CMA	Chengli	Qi	ESA	Anne-Lisa	Pichler
CMA	Shengli	Wu	EUMETSAT	Alessandro	Burini
CMA	Na	Xu	EUMETSAT	Dorothee	Coppens
CMA	Zhe	Xu	EUMETSAT	Tim	Hewison
CMA	Hanlie	Xu	EUMETSAT	Vinia	Mattioli
CNES	Clemence	Pierangelo	EUMETSAT	Peter	Miu
CU-Boulder	Odele	Coddington	EUMETSAT	Rosemary	Munro
DLR	Diego	Loyola	EUMETSAT	Rob	Roebeling
DWD	Karsten	Fennig	EUMETSAT	Sebastien	Wagner
ECMWF	William	Bell	Ewha Womans University	Yeeun	Lee
ESA	Clement	Albinet	Fluctus Sas	Bruno	Picard
ESA	Jerome	Benveniste	ISRO	Nitant	Dube
ESA	Jerome	Bouffard	ISRO	Pradeep	Thapliyal
ESA	Paolo	Castracane	JAXA	Misako	Kachi
ESA	Matteo	Corona	JAXA	Hiroshi	Murakami
ESA	Raffaele	Crapolicchio	JAXA	Tomoyuki	Urabe
ESA	Angelika	Dehn	JMA	Kazuki	Kodera
ESA	Andrea Della	Vecchia	JMA	Masaya	Takahashi
ESA	Georgia	Doxani	JMA	Yusuke	Yogo
ESA	Lia	Fonseca	KMA	Minju	Gu
ESA	Ferran	Gascon	KMA	Dohyeong	Kim
ESA	Philippe	Goryl	KMA	Jin	Woo
ESA	Steven	Hosford	NASA	Rajendra	Bhatt
ESA	Giuseppe	Ottavianelli	NASA	David	Crisp

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NASA	David	Doelling
NASA	Edward	Kim
NASA	Xu	Liu
NASA	Thomas	Pagano
NASA	Xiaoxiong	Xiong
NCMRWF	Srinivasa Prasad	Vijapurapu
NIST	Stephen	Maxwell
NOAA	Manik	Bali
NOAA	Ralph	Ferraro
NOAA	Lawrence	Flynn
NOAA	Mitch	Goldberg
NOAA	Rachael	Kroodsmas
NOAA	Quanhua	Liu
NOAA	Bomin	Sun
NOAA	Sirish	Upreti
NOAA	Xiangqian	Wu
NOAA	Fangfang	Yu
NOAA	Cheng-Zhi	Zou
NPL	Nigel	Fox
PMOD	Julian	Grobner
RAL	David	Smith
Rayference	Yves	Govaerts
RESTEC	Taichiro	Hashiguchi
ROSHYDROMET	Alexey	Rublev
ROSHYDROMET	Alexander	Uspensky
SITP	Lei	Ding
UKMO	Fabien	Carminati
UKMO	Roger	Saunders
UMD	John	Yang
UMD	Yalei	You
University of Hamburg	Martin	Burgdorf

USGS	Tom	Stone
VITO	Stefan	Adriaensen
WMO	Toshiyuki	Kurino