

Minutes of 2014 GSICS GRWG/GDWG Meeting (24-28 March 2014)

Presentations are available on the GSICS Wiki:

<https://gsics.nesdis.noaa.gov/wiki/Development/20140324>

Summary of Discussion following each agenda item:

Mini Conference am	Mon am
Chair: Tim Hewison	

1a	Introduction to Mini Conference & GSICS	EUMETSAT	Tim Hewison
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Tim provided an introduction to GSICS for new members and visitors and introduced the practicalities of the Mini Conference.

1b	Welcome to EUMETSAT	EUMETSAT	Jo Schmetz
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Jo is one of the founders of GSICS. He mentioned the important contribution of Paul Menzel in GSICS. After introducing EUMETSAT satellite system informed about the history of GSICS. He informed that GSICS has its roots in CGMS. It began formally in 1997. Interesting information about imaging and sounding capability of MTG and GSICS's contribution to it's calibration was shared by Jo.

Dave Doelling asked about the benefits of Moving one MSG satellite over the Indian Ocean and take measurements over a less covered area,

1c	GOME2 as hyperspectral reference for MSG & AVHRR	EUMETSAT	Ruediger Lang
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GOME-2 can be efficiently used to inter-calibrate channel one reflectivity levels of AVHRR/Metop (at 0.999 r-square levels) and SEVIRI/MSG (at 0.98 r-square levels). No offset is found for both instruments with respect to GOME-2 convolved channel 3 and 4 reflectance levels, but the gain differences are on the order of 10% underestimation for AVHRR and 8% underestimation for SEVIRI. These levels are stable between 2007 and 2011.

However GOME-2 is degrading (~2%) in this wavelength range in the last few years. This degradation is also viewing angle dependent. However once a correction is applied one can recover the expected gain and offset. SEVIRI/MSG-3 Vs GOME2-Metop inter-comparison has a larger scatter because of the different platform and potentially because effects of spatial aliasing that are not yet accounted for. Ruediger proposed this as a side product for GSICS.

Larry asked if other locations with non-nadir views of GOME-2 can be used for the SEVIRI comparison. Answer: Yes but only at reduced accuracy, and statistics for the SNO situation should be sufficient.

Dave asked about the impact of spectral calibration accuracy of GOME-2. This is done onboard using lamps and its accuracy is on the order of 1e-4 nm.

1d	GOES Imager lunar calibration: Angular variation of the scan mirror reflectivity	NOAA	Fangfang Yu
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Fangfang first introduced the history of GOES Imager scan-mirror angular dependent emissivity/reflectivity study at NOAA. Then she informed about the issues of quantization of stray light and paired lunar observations. Uncertainty analysis was made of lunar measurement. A formula to compute uncertainty was stated. Her findings suggest the E-W oversampling factor is not constant in GOES-15, and that an incident angle dependent reflectance is apparent and comparable with the lab measurement.

The scan angle reflectivity and stray light are two main uncertain factors in Lunar calibration. It was pointed out that the issue of oversampling could be answered by the instrument vendor.

1e	FY-3C/MERSI characterization evaluation based on CMA GISCS platform at early time on orbit	CMA	Scott Hu
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FY3C has the third medium resolution imaging spectrometer (MERSI). It is more stable than previous instruments (FY-3A , FY-3B) of its family. MERSI was turned on Sep-Oct 2013. MERSI is similar to MODIS and VIIRS. A table of MERSI event log since its launch was displayed. Results of DCC and PICS to monitor instrument degradation were presented. The lunar calibration method is also first used to calibrate the instrument by space viewing observation. Inter-comparison using NPP/VIIRS and EOS/MODIS etc was done. Long-term instrument monitoring for its IR band is done by comparing with NPP/CrIS and shows the small bias within 0.5K.

1f	VIS/NIR recalibration of Heritage Instruments	EUMETSAT	Rob Roebeling
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Recommendation for climate measurements better than 1K. The infrared re-calibration will use HIRS as a reference instrument. The HIRS/2 is found to be a better reference than HIRS/3. IASI and AIRS will be used to mimic HIRS/2. The HIRS/3 data will not be used for this re-calibration activity. EUMETSAT will build a database of SNO collocations between their MVIRI and SEVIRI monitored instruments and sounder reference instruments (HIRS/2, HIRS/2 (based on AIRS), HIRS/2 (based on IASI), AIRS and IASI).

To achieve this recommended level of accuracy (1K) for climate products, SCOPE-CM IOGEO (Inter-calibration of passive imager observations from time-series of geo stationary satellites) requires recalibration of the archive all geostationary satellites - for IR, WV and VIS channels, over the full reflectance range. EUMETSAT contributes to SCOPE-CM IOGEO with the re-calibration of the series of MVIRI and SEVIRI instruments, and plans to develop and apply double differencing approach and is preparing an SNO database.

There was a discussion on the approach for CDRs to be based on raw counts, which was recommended in the CREW workshop. Rob clarified that it includes the complete process of converting these counts to radiance/reflectance in an absolute sense (best fit to spectral response function) and in a relative sense (best fit to a chosen reference instrument). It was agreed that GSICS should continue to focus on the lowest level data generally available to the public (usually L1, not L0 raw counts).

1g	Free Tropospheric Humidity from Ring of Geostationary Satellites	DWD (CM SAF)	Marc Schroeder
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Marc presented this contribution to a SCOPE-CM project, whose overall goal is to provide a geo-ring FTH demonstrator product. The product was compared against ARSA radiosondes. Comparison against

HIRS UTH exhibits bias due to utilisation of different weighting functions. Marc pointed out that the *Common Reference Channel* approach eases application in model evaluation and assimilation.

Tim pointed out that coefficients to convert between radiance to brightness temperature are imbedded in netcdf data file. Marc requested that these be incorporated in future GSICS ARC products.

Fangfang commented on the large bias in GOES-11 and GOES-12 channel.

Dave Doelling asked how stable the relative humidity is over a large period of time. Marc replied that on a global scale relative humidity seems to be constant when looking into the available literature.

Recommendation: Marc Schroeder (DWD) to share ATBD to define Common Reference Channels with GRWG for voluntary review.

1h	AVHRR-IASI & AATSR/SLSTR	EUMETSAT	Anne O'Carroll
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Highlighted the time gap between end of AATSR and launch of SLSTR. IASI would be used in the order to fill the gap. So AVHRR / IASI inter-comparison is important to filling this gap. Anne introduced the current Cal/Val activities of SLSTR instrument. This instrument is due to be launched in 2015.

For the SLSTR and AVHRR inter-comparison there would be a collocation data including L0 data.

Tim asked about the plans for involving with GHRSSST community. This will be discussed in next GHRSSST meeting.

1i	Status of SCOPE-CM inter-calibration projects (IOGEO and AVHRR FCDR)	EUMETSAT	Rob Roebeling
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Rob started with a Product Maturity Matrix that is under development. Maturity takes time: cloud products have taken ~12 yrs to mature and SST data sets take ~5 yrs to mature. The SCM-05 project is advancing the status of the AVHRR FCDR.

Rob explained the SCOPE-CM project SCM-06, which aims to develop inter-calibration of passive imagers observation from time-series of geostationary satellites. This approach uses GSICS methodology. Agencies already participating are EUMETSAT, JMA, KMA, NOAA and CMA. The involvement of KMA and IMD, as well as NASA, was discussed in this meeting. SCM-06 aims to adopt a common recalibration approach at NOAA, JMA and EUMETSAT. The project considers providing a re-gridded data record of relatively recalibrated VIS, IR and WV products, similar to GridSat but at higher spatial and temporal resolutions. This will be further discussed.

1j	FCDR from SSM/I	DWD (CM SAF)	Marc Schroeder
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Marc presented the CM SAF FCDR of SSM/I on-board the DMSP satellites F08, F10, 11, F13, F14 and 15. F11 is used as reference because it exhibits a high degree of linearity in calibration.

Tim Hewison noted that this is a very mature FCDR and proposed the inter-calibration part of this FCDR could become a GSICS product. Marc has already started planning to submit it to the GPPA and would appreciate support from the GCC.

1k	Exec Panel Report & GSICS Vision	WMO	Tim Hewison for
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			Jerome Lafeuille
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Tim Hewison gave this presentation on Executive Panel's Vision for GSICS into the 2020s. In this vision following questions were addressed: What are we aiming at, How is the context evolving; What to do, how and with whom; and which instruments to address.

Highlights included the need to maintain one calibration reference standard for each spectral band from IR to VIS/NIR and MW. GSICS' involvement in active sensor calibration is not decided. To be evaluated taking into account CEOS/WGCV.

The GSICS Vision also highlights the need to be part of international calibration community (including BIPM, WMO/CIMO CEOS/WGCV) and for interaction with the L2 community. Larry pointed out that different L2 products have very different calibration requirements, some of which may not be achievable using the "one-size-fits-all" approach adopted by GSICS so far. However, there is clearly scope for mutual benefit of such interaction in terms of better understanding of the instrument's calibration and GSICS' inter-calibration algorithms.

Jerome's vision also highlighted the need to document GSICS processes, which ultimately can be published as WMO Guides. Manik asked about the format of these guides, which would need to be established with WMO.

1l	METimage calibration concepts	EUMETSAT	Pepe Phillips
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Pepe's presentation on the calibration concepts being considered for the METimage instrument due to fly on EPS-SG generated a lot of interest and discussion - particularly regarding the design featuring 2 solar diffusers and associated technical aspects. During discussion it was pointed out the SRFs can be characterised on ground to a sub-percentage level, so the differences between the 3 flight models will have a minimum contribution to the uncertainty of its radiance products for climate applications. However, it was also pointed out that the threshold calibration accuracy required of 5% would severely limit its application for climate monitoring.

1m	3MI calibration concepts	EUMETSAT	Thierry Marbach
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Thierry confirmed that the 3MI calibration strategy is based on vicarious calibration using Rayleigh scattering, as it has no on-board calibration reference. Inter-calibration against the METimage on the same platform is planned for validation and calibration monitoring. It is also possible to perform inter-calibration against other LEO instruments and geostationary imagers, such as MTG-FCI.

1n	Ocean Colour Instrument Calibration	EUMETSAT	Ewa Kwiatkowska
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Ewa explained that the signal from chlorophyll is an order of magnitude smaller than the signal. So a 1% error in L1 (radiance) will create a 10% error in the L2 product. The system requirements on OLCI are <2%, so the operational retrievals will rely on vicarious calibration in L2 product-space using in situ buoys. This turn, introduces a need to analysis of L3 climatologies to validate L2 products. There was much discussion on various aspects of the uncertainties involved in ocean colour products.

Recommendation: Ewa Kwiatkowska agreed to formulate suggested wording for recommendation from GRWG to the Ocean Colour Community to provide a full uncertainty analysis (including correction of atmospheric contribution by RTM) for GRWG members to review.

1o	EUMETSAT's Lunar Calibration Capabilities	EUMETSAT	Sebastien Wagner
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Sebastien described the lunar calibration system implemented at EUMETSAT and demonstrated its capability for monitoring instrument calibration and showed examples of its ability to detect anomalies in the operational calibration. He also described how observations of the Moon can be used to characterise instruments' MTF in orbit.

A.K.Sharma asked about application of EUMETSAT's lunar calibration system to Kalpana data. This was covered in the meeting on Wednesday afternoon and proposed lunar calibration workshop.

1p	TRUTHS	NPL	Nigel Fox
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Nigel explained the traceability chain behind the development of cryogenically-cooled radiometers, and how this could be implemented in orbit in the context of the proposed TRUTHS mission. NPL is already funded to conduct uncertainty analysis for TRUTHS as an inter-calibration reference. First results suggest total uncertainties $\ll 1\%$ and probably $< 0.5\%$ are achievable and limited only by the knowledge of the monitored instrument's SRFs.

Nigel expressed an interest in collaborating with NASA and/or third parties with CLARREO teams for joint-funded collaboration - for example, to develop a technology demonstrator. Scott Hu expressed an interest in collaboration with CMA to fund this further. Nigel received this suggestion enthusiastically, explaining discussions had already started with different agencies in China under a bilateral MoU with the UK. CMA have also instigated discussions with instrument manufacturer for flying on FY platform or space station.

Recommendation: CMA to follow-up bilaterally with NPL to discuss how to pursue potential implementation of a TRUTHS-like instrument on a Chinese satellite.

1q	CLARREO Update	NASA	Dave Doelling for Bruce Wielicki
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Dave explained that CLARREO is still in pre-Phase A status. The science team's effort has been focused on building support in the community by presenting the concept at conferences, and publishing papers showing the benefit of operating an SI-traceable instrument in space.

This is currently being followed up by funding two independent demonstration instruments for both the Reflected Solar and Thermal Infrared bands. One of these has successfully been operated on a balloon to obtain Sun and Moon observations.

Action: Bruce Wielicki (NASA) to investigate availability of lunar observation data from CLARREO demonstrator test flight and share these with CNES and USGS and notify CNES of future balloon flights so Pleiades observations can be synchronised.

1r	GRUAN - SAT v RAOB+RTM	EUMETSAT	Xavier Calbet
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Xavier explained that of the GRUAN sites, only Manus is well located with launches at 00 and 12 UTC to collocate well with IASI. But these only generated 8 clear sky collocations in one year and showed how consistency check can reduce collocation errors to a minimum.. GRUAN humidity needs to be corrected with RH+3% to account for a bias which is likely to be in the RTM. Comparisons of observed radiance spectra with those modelled from RTM and GRUAN radiosondes suggest another RTM issue with the water vapour continuum. He also showed that for most atmospheric levels, the collocation error for humidity, in Manus, can be modelled with ECMWF, but the ECMWF humidity not accurate at 200 hPa in this region.

More interaction possible between RTM, satellite and radiosonde groups would help resolve these discrepancies, and will be followed-up in a dedicated workshop at WMO in May 2014.

1s	CEOS WGCV IVOS - GSICS Interactions	NPL	Nigel Fox
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Nigel explained the structure of IVOS and the range of activities supported through task forces and projects, including RadCalNet and SST/LST . They are looking for new participants in the R
Nigel presented the IVOS Terms of Reference, which have recently been extended to include traceability.

1t	Discussion		All
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In the following discussion it was agreed that more investment in infrastructure for pre-launch characterisation is needed, but space agencies are pretty conservative in setting up new systems to do this. It was suggested that more stringent user requirement on pre-launch characterisation could be used to drive this, but the requirements for climate monitoring are not always clear on this - although it should be covered by GCOS.

Nigel outlined potential topics for IVOS-GSICS interactions, which include:

- review procedures for sensor-sensor cross-calibration on orbit
- case studies on the benefits of cal/val
- Joint meetings on specific topics

To was suggested that IVOS contributors be invited to submit articles for publication in the GSICS Quarterly newsletter - maybe as regular dedicated special issues. This offer could be extended to WGCV.

IVOS members are welcome to sign-up to GSICS developers mailing list (gsics-dev@googlegroups.com). One contact could be nominated to subscribe and disseminate relevant messages to any interested parties.

Action: Nigel Fox to follow-up invitation for IVOS and WGCV contributors to submit articles to the GSICS Quarterly newsletter.

Plenary - Briefs			Tues am
Chair: Tim Hewison			

2a	Round Table Introductions		All
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After the self introduction of all attendees, Tim expressed his appreciation to the first participation of IMD, ISRO and NPL representatives on behalf of the GSICS.

2b	Agree Agenda & Minute Taking	EUMETSAT	Tim Hewison
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Tim requested presenters to keep their assigned 20 minutes slot, then proceeded to exceed it. All of the attendees agreed upon the modified agenda. Tim also called for volunteer minutes takers using Google Docs.

2c	GRWG Briefing Report & Microwave Sub-Group Report	EUMETSAT	Tim Hewison
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Tim reported on current status of GSICS products. As for GEO-LEO IR products, NOAA and EUMETSAT have products in pre-operational phase and the NOAA product is almost in operational phase. After a quick review of the GSICS web meetings for the past year, the attendees confirmed outstanding GRWG

actions. Currently, actions and recommendations are maintained on GSICS wiki, but he requested GDWG to improve the system. In particular, automatic reminders of action due date to a responsible person is expected.

Tim proposed work plans for 2014. GEO-LEO IR products in pre-operational phase will be moved to operational phase. GEO-LEO VIS product using DCC method should enter demonstration phase after discussions of filename and NetCDF conventions. He also suggested that new product category, Archive Re-Calibration, and potential future GSICS products such as lunar calibration and rayleigh scattering, which were discussed in the GRWG session.

He emphasized that management roles and responsibilities of WG chair, vice chair and sub-group chairs should be defined to discuss future chairing. He proposed formation of an Infrared Sub-Group to continue the development of inter-calibration products for that spectral band and offered to chair the group if a replacement could be found to chair the GRWG.

Tim also reported microwave sub-group progress on behalf of Cheng-Zhi Zou. In August 2013, reformation of the sub-group was completed. An AMSU/MSU FCDR was reviewed and it entered pre-operational phase in early 2014.

2d	VIS/NIR Sub-Group Report	NASA	Dave Doelling
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Dave started his presentation by stressing the importance of well-calibrated satellite data because users may misunderstand sensor calibration changes as a climate change. VIS/NIR calibration has been improved step by step. At present, the calibration stability reached 1%/decade for desert targets and 0.5%/decade for DCC targets. In next 10 years, it is expected to be reduced to 0.3%/decade. He also pointed out that reference sensors must be freely available, stable, and traceable with future instruments.

Dave reported possible calibration methods of VIS/NIR instruments: DCC, Lunar, Rayleigh scattering and so on. In order to implement the calibration method within GSICS, corresponding ATBDs are necessary. At present some can be found on GSICS Wiki.

Sebastien asked how do we get on the calibration of next generation geostationary satellites and Dave answered that we can aim to use VIIRS as an inter-calibration reference.

2e	UV Sub-Group Report	NOAA	Larry Flynn
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Larry reported the UV sub-group progress. This group was set up in 2013 and Larry accepted the interim chair. He introduced four projects at a web meeting in February 2014. Comparison of solar observation and calibration using at least two different high resolution instruments is needed. The group is now creating a list of instrument and project leaders. Larry called for volunteers.

Larry introduced projects of reflectivity channel comparison. Each project will proceed for a goal of the comparison: 1% on cloud free scene reflectivity for 340nm and 2% for profile channels from 240nm to 290nm. The progress will also be reported in the special issue of GSICS Quarterly in fall 2014. He also noted that at least three UV instruments will be on geostationary satellites in the coming years. Tim appreciated Larry's initiative of the sub-group.

2f	GDWG Report	NOAA	Manik Bali
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Manik reported the progress of GDWG for the past year. Activities of the GDWG such as netCDF metadata convention, data archiving and satellite event log database are necessary for all of the GSICS

activities, so he looked back on the past achievements. As of March 2014, 17 of 24 actions of GDWG are closed. He briefly introduced the progress of each GRPC: NOAA, JMA, EUMETSAT, CMA and KMA.

In 2014, GDWG will discuss how to maintain current services such as THREDDS server, GSICS product catalog and GSICS Wiki. The group will also set up satellite event logs and improve the EUMETSAT bias plotting tool in collaboration with GRWG.

Action: GDWG to investigate how many people currently use GSICS products.

2g	GCC Report, incl 2013 Users Workshop	NOAA	Larry Flynn
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Larry reported the GCC progress after his introduction of the membership change. For the past year four GSICS Quarterlies were issued using GSICS User Messaging Service. GCC supported a formation of new sub-group on UV instruments. GCC also hosted GSICS Users workshop at NOAA in April 2013. Larry reported the MW AMSU/MSU product was promoted to pre-operational phase. At that time, a new approach i.e GSICS awards, to reviewers were applied. In 2014, the GCC website will be updated.

Tim suggested reviewing the roles of GDWG and the GCC because there seem to be some duplication. Manik proposed leading a paper to be submitted to a peer-reviewed journal to provide an overview of GSICS Products. He will solicit contributions from those responsible for generating each product.

2h	Requirements to Improve the Procedure for Product Acceptance	EUMETSAT	Pete Miu
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Peter proposed GPPA improvement by automating the steps. Current GPPA is seen as too complicated and there are no periodic meetings to discuss, so all of the GSICS products have yet to reach operational phase. His idea is to set up websites (e.g. wiki or cloud) for documents and products submission for reviewers. Peter also proposed to set up webpage: "make a choice" using Doodle for reviewer's recommendation and comments. Automatic alerting function by setting a hard limit can be supported. Larry commented that the importance of product navigation (package to be validated) for reviewers.

2i	Instrument Event Logs	EUMETSAT	Rob Roebeling
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Rob introduced an overview of satellite event logging. This is ongoing in the framework of CGMS and reconsidered in 2014. The current plan of the logging consists of three steps. As a first step, Rob proposed to include the information in the WMO OSCAR in 2015. Calibration event database which have been discussed will be realized in the future. Rob asked all GPRCs to provide satellite instrument specific links to calibration events to WMO-OSCAR. Second, Rob asked all GPRCs to seek consensus on common naming conventions for calibration events. Third, Rob indicated that EUMETSAT and NOAA will define and a calibration events database design, and asked all GPRCs to review the design and test its robustness through a pilot study. This logging was discussed further in the GDWG breakout session.

2j	CMA GPRC Report	CMA	Scott Hu
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Scott gave an update on CMA's core activities related to GSICS, which focus on on- and off-line calibration monitoring, recalibration system, and cal/val system. CMA's CRCS Dun Huang desert site has been enhanced to include new hyperspectral transmittance and ASD measurements to complement AOD from solar photometer and IR measurements.

Satellite inter-calibration has also been extended to include use of CrIS, Metop-B/IASI, NPP/VIIRS and GOME-2 as reference instruments. Their website has been correspondingly extended.

FY-2 now uses onboard BB calibration, instead of GSICS inter-calibration, but is now much more stable than before. FY-3B/VIRR is more stable and linear than FY-3A/VIRR. PICS is not suitable for monitoring WV bands, due to strong seasonal cycles. DCC method applied to FY3A/MERSI shows deterioration has been decelerating in recent years.

CMA are planning to start generating GSICS Corrections for FY2-D,-E & -F and will report at the next meeting.

2k	CNES GPRC Report	CNES	Bertrand Fougnie
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CNES are continuing to develop the BRDF model used in desert sites, as well as the atmospheric correction - particularly the aerosol contribution. The latter has been validated by comparing the distribution of the correction with observations from nearby EARONET sites. Desert-based inter-calibration is continued to be developed at CNES for a range of sensors.

Further developments of Rayleigh Scattering ATBD include migration from using a climatological aerosol profile to observations. This should reduce the overall uncertainties applied to some bands.

CNES has also continued to derive the BRDF of DCCs from Parasol observations, as reported in the 2013 web meeting. These will be compared to the BRDF from the Hu model.

CNES are also implementing a “massive cross-calibration” project to inter-compare multiple sensors based on QSNO. These confirm IASI-A and -B and CrIS are very stable.

2l	IMD GPRC Report	IMD	A.K.Sharma
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AK introduced India’s new INSAT-3D satellite, its imager and sounder instruments, and L2 products IMD derives from them. He also described a joint activity to establish a cal/val site in India to support the calibration of the visible channel of this sensor. This site covers a 3x2km area in the desert of Rajasthan, near Jaisalmer. It was surveyed by ASD and instrumented to observe AOD and total column ozone and water vapour for a campaign during December 2013. AK reported difficulties getting modelled TOA radiances to match the observations on a daily basis, which were attributed to spatial variability. Final results will be presented in future meeting after completing the ongoing analysis.

Potential coordination with IVOS was identified to select suitable sites for geostationary imagers. Also, potential new sites could be identified from BJ Sohn’s MODIS dataset, previously reported at GSICS, which can be made available for analysis.

Nigel Fox mentioned a new ESA & CNES study to select optimum calibration sites worldwide. EUMETSAT can also share details of the Arabian sites which may be visible to INSAT-3D.

2m	ISRO GPRC Report	ISRO	Pradeep Thapliyal (Remote)
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Pradeep presented ISRO’s inter-calibration activities via Webex, before leaving to catch his flight to join the meeting on Thursday. Nevertheless he was able to explain the progress made in developing GSICS Corrections for the IR channels of both current and past geostationary satellite instruments - both imagers, and the sounder on the new INSAT-3D. These will be reviewed in more details in Thursday’s IR session.

2n	JAXA GPRC Report	JAXA	Keiji Imaoko (Remote)
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JAXA activities include the launch of GPM Core satellite, releasing the first image today. This is important for GSICS, as it provides the cornerstone of the GPM virtual constellation, and may provide a vital reference for future inter-calibration products.

Keiji also reported the calibration status of AMSR2 instrument on GCOM-W, which shows differences to AMSR-E, which is now operating in a slow scan mode. Similar patterns are found from untargeted SNOs and targeted observations of rainforests and oceans. These should be resolved by comparison with the new GMI imager.

Keiji also provided an update on GOSAT TIR intercomparisons and introduced the SGLI VIS/IR imager, which will operate on GCOM-C1. This includes onboard bb and solar diffusers, and will also be able to view the Moon.

2o	EUMETSAT GPRC Report	EUMETSAT	Sebastien Wagner
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Sebastien provided an update on EUMETSAT's satellites and outstanding actions from previous GSICS meetings. He also reported on the status of EUMETSAT's GSICS server and the various activities related to the development of GSICS products, which are reported in other sessions of this meeting.

2p	JMA GPRC Report	JMA	Masaya Takahashi
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Masaya introduced JMA's new representatives of GSICS Executive Panel, Data and Research Working Group. JMA's progress on GEO-LEO IR products includes reformatting the netCDF files to adhere to GSICS conventions, and analysing the diurnal cycles and uncertainties, which should be completed during 2014. Masaya also reported comparisons of various visible channel calibration techniques with NASA's DCC method and other preparations for DCC products to enter demonstration mode. He also reported early results from applying EUMETSAT's lunar calibration system to MTSAT-2, which are very encouraging.

Masaya will also contribute to two SCOPE-CM projects, as a user of GSICS products and algorithms. He highlighted one problem with these activities, due to the unavailability of MODIS to re-calibrate older archive data. The report also includes plans to apply vicarious calibration methods to Himari-8/AHI.

Masaya also reported on a prototype calibration change alert system.

Dave asked whether Masaya could isolate the RTM component of the JMA's DCC vicarious calibration method. This will be investigated during Masaya's stay at EUMETSAT.

2q	KMA GPRC Report	KMA	Minjin Choi
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Minjin reported on KMA's ongoing activities on vicarious calibration of COMS's visible channels and GEO-LEO inter-calibration of the IR channels. The former show a degradation of 2.1%/year, while lunar calibration results suggest only 1.2%/year. These will be discussed more tomorrow. Inter-comparisons with IASI and AIRS generally give consistent results, except for cold scenes in the SWIR band. These are displayed on very nice new pages on the KMA website.

Minjin also reported a positive impact of GSICS-based re-calibration on COMS L2 products, which reduced the bias in SST when validated against in situ buoys and also in solar insolation.

KMA are preparing to generate GSICS Corrections for GEO-LEO IR routinely and submit these to the GPPA.

2r	NASA GPRC Report/MODIS & VIIRS Status	NASA	Jack Xiong
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Jack gave an update on the status of the MODIS instruments operating on Terra and Aqua, the latter of which is currently the GSICS reference instrument for the VIS/NIR bands. He also described how the calibration of SNPP/VIIRS has improved as a result of extensive post-launch investigations to the point where it may be considered as a GSICS reference instrument in future. This will be discussed further in the VIS/NIR session.

2s	NOAA GPRC Report	NOAA	Fangfang Yu
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Fangfang reported on NOAA's calibration-related activities that are not reported elsewhere in this meeting - in particular the NOAA/NESDIS/STAR Integrated Cal/Val System for Long-Term Monitoring (ICVS LTM), which has been developed to integrate GSICS products with Instrument Performance Monitoring for all NOAA's weather instruments, in preparation for GOES-R and has the capacity to generate calibration anomaly reports. She showed examples of how users can investigate the root cause of calibration anomalies using the system.

The tool is publically accessible at: <http://star.nesdis.noaa.gov/icvs/> and is currently applicable to the following sensors:

Suomi NPP: Spacecraft Telemetry, ATMS, CrIS, VIIRS, OMPS Nadir Mapper, OMPS Nadir Profiler, OMPS Limb Profiler

Metop-B: AMSU-A, MHS, AVHRR, HIRS

NOAA-19: AMSU-A, MHS, AVHRR, HIRS

Metop-A: AMSU-A, MHS, AVHRR, HIRS

NOAA-18: AMSU-A, MHS, AVHRR, HIRS

GOES-13 Sounder, Imager

GOES-15 Sounder, Imager

DMSP F17 SSMIS

2t	USGS GPRC Report	USGS	Greg Stensaas (Remote)
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This report was postponed due to Greg not being available. It will be distributed by email.

GRWG: GEO-LEO VIS DCC		Wed am
Chair: Dave Doelling		

3a	Introduction to VIS/NIR session and ray-matching	NASA	Dave Doelling
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Dave reported good progress in developing a ray-matching approach to inter-calibration using individual Deep Convective Clouds. Unmatched ray-matching gives a lot of scatter (~4%), partly due to differences in SRFs and the uncertainty introduced by the applying the SBAF to different scene types. DCC ray-matching generates very restricted datasets, although the collocation criteria can be relaxed from the untargeted approach because of the Lambertian nature of the targets. But scatter is reduced to <1%. However, jumps of 1-4% are seen from month-to-month.

Decision: The VIS/NIR Sub-Group plan to continue to develop untargeted DCC method as GSICS product, while continuing to research DCC ray-matching for future products, when contemporaneous observations are available.

3b	Implementation of DCC at JMA and comparison with RTM	JMA	Keita Hosaka
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Keita reported that JMA have implemented a variant of Dave's DCC ATBD, without the homogeneity check. He found the mode to give more stable results than the mean, both produced similar gain trends to JMA's vicarious calibration system. He also reported results using a 30d moving average, which would be suitable for NRT products. No obvious seasonal cycles were observed in the MTSAT domain.

JMA plan to upload the results to the EUMETSAT GSICS server once the netCDF content and format are defined.

Comparisons with RT simulation were complicated by not fixing the regression to pass through zero radiance. Despite this, this modelling is very valuable to help GSICS understand the DCC properties.

Recommendation: JMA to run RTM simulations over only Aqua/MODIS DCCs.

3c	VIS/NIR inter-calibration of FY3 and FY2 by DCC	CMA	Lin Chen
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Chen reported RTM simulations over DCCs which showed the results were very sensitive to aerosol. Chen also investigated DCC application using FY3A/MERSI. However, the results are complicated by the intermittent changes in the operational calibration to correct for degradation. On the other hand, the calibration of FY3C/MERSI was much more stable, and it gave more stable DCC results. Comparisons with Terra/MODIS, including SNO results suggest significant non-linearity in the FY-3C/MERSI calibration. However, this cannot be confirmed by the DCC method alone.

Application to FY2 was also complicated by its erratic IR calibration, although no big differences were found before and after applying the GSICS-based calibration to them. CMA's results suggest some of the features reported by JMA could be caused by their IR thresholding.

3d	NOAA GPRC DCC operational implementation	NOAA	Fangfang Yu
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Fangfang also showed encouraging first results for DCC ray-matching method, with more relaxed collocation criteria than Dave's. She stressed the need for a long-term dataset to establish the seasonal cycles in the reference DCC reflectances because in addition to season cycles, there are also annual cycles in the GOES results.

Fangfang also reported on an analysis of the median and mode. The difference was <0.4%, but the median had slightly lower standard error. She also looked at different BRDF models and found small, but systematic differences (0.11% and 0.27% for CNES and CERES, respectively wrt Hu) in the results.

3e	DCC ATBD implementation & requirements	EUMETSAT	Sebastien Wagner
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Sebastien has implemented Dave's DCC ATBD and investigated different variations, but still needs to finalise the uncertainty analysis.

He highlighted the problem of saturation for SEVIRI VIS0.6 channels - although this is getting less serious as the instrument's gain deteriorates with age. Seb raised the questions of what we want for a product - e.g. fitted yearly drifts, monthly-cumulated drift, etc. This will be discussed.

Seb also looked at the difference between mean and mode. Both gave similar long-term trends in drift (from variogram analysis) - both before and after removing saturated pixels.

Action: Dave Doelling to provide EUMETSAT with DCC SBAFs for Met-8 and -10 by June 2014.

3f	SBAF for DCCs	NASA	Dave Doelling
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Dave presented a comparison of SBAFs derived from SCIAMACHY, GOME-2 and Hyperion over Libya-4, showing differences of 0.4% in the Vis (band 1), and 0.1% difference in band 2. For bright high cloud (extended definition of DCCs), a SD of 0.5% was found across the whole spectrum. DCC reflectance spectra is now 5% brighter - and very close to 1 now.

There was a question about the stability of the SCIAMACHY data used. This will be improved in future versions, but mostly at the shortest wavelengths (<500nm) - up to 15%(!) at high view angles. Matthijs Krijger (SRON) was happy that the current results would not be significantly impacted.

3g	Update on DCC BRDF from PARASOL	CNES	Bertrand Fougnie
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Bertrand has evaluated the BRDF of the "mean DCC" from PARASOL data over 15°-60° SZA. Selection criteria differ from the GSICS ATBD, due to the absence of IR channel. Data is binned for VZA, RAA and SZA, in each of the bands. He also presented preliminary comparisons with other BRDF models, which is ongoing. He plans to construct theoretical BRDF model in future.

The observed BRDFs appear noisy. Bertrand recommended that they be smoothed prior to application. It was agreed that he should perform this smoothing, given his expertise with the dataset.

Action: Bertrand Fougnie to provide smoothed DCC BRDFs derived from PARASOL observations.

Recommendation: CNES to repeat BRDF analysis from PARASOL over land in Africa and report at web meeting.

3h	Aqua to NPP Transition	NASA	Jack Xiong
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Planning the transition from MODIS to VIIRS is necessary for the long-term support of GSICS products. Jack addressed different methods to perform this. He highlighted the problems of using the Moon observations, as it is observed in different phases by each instrument. This could contribute to the observed 5% differences in measurement/model from MODIS and VIIRS in some bands (e.g. 0.65µm).

Decision: It was agreed that delta corrections will be needed for each specific GSICS products, which can be derived from double-differences of applying MODIS and VIIRS as independent references in each algorithm.

3i	Visible product and bias monitoring	All	Discussion
	Path towards DCC demonstration product		

Sebastien Wagner presented ideas for contents and format of netCDF files for GSICS DCC products for GEO-LEO VIS channels.

These were reviewed in turn by editing the PowerPoint file.

Pete Miu explained the GDWG plans to allow netCDF files global attributes and variables to be customisable in future to allow users to select the content they need - e.g. for basic, expert users.

Decision: Meanwhile, demo products will include one global attribute to describe all the configuration of the algorithm needed to provide traceability to ensure the product is reproducible by the creator.

Action: GDWG to investigate methods to structure the order the global attributes within the netCDF file - e.g. between attributes related to the method and the application.

Action: GDWG to investigate how to include algorithm type in filename.

Decision: DCC products will follow a similar style as current GEO-LEO IR ones - ie multiple NRTC files each containing results for single day, and a single RAC file containing results for the whole time series - preferably in daily time steps, or otherwise monthly.

Solar Constant=Variable[chan]

SBAF = Variable[chan]

Space count offset + uncertainty =Variable[chan,date] - for users

PDF=intermediate

Action: Sebastien Wagner to share strawman netCDF file for DCC products for review at web meeting.

Web Meeting: Review of strawman netCDF file for DCC products.

3j	COMS VIS: Moon	KMA	Minjin Choi
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Four targets used by KMA for COMS vicarious calibration (ocean, desert, liquid water and deep convective cloud). Together these give a degradation rate of ~4%/yr. Lunar calibration results suggest a lower rate of degradation (1.2%/yr) , based on 68 cases over 22 months. SD~1.7%. Minjin reported an apparent annual cycle, which was strongly correlated to satellite latitude and longitude, which she suggested could be an effect of the lunar libration.

Recommendation: KMA to validate their implementation of ROLO model against that of other GSICS members.

3k	Aqua/MODIS and VIIRS lunar observations	NASA	Jack Xiong
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MODIS has the capability to command the acquisition software to sample the Moon when it is close to the Earth's limb, without needing to steer the spacecraft. This way it can view the Moon always in the same range of phase angles (+/-55°, symmetric) through the same optics, but at a different mirror angle. However, there is systematic difference between opposite phase angles. The results also show a dependence on the lunar libration angle (~1%).

Jack also presented results of spatial characterisation using the Moon, specifically to investigate the band-to-band registration. This is possible along- as well as across-scan (although it is harder). Jack also warned about optical and electrical leaks between the very strong signal in the IR and the weak signal in the VIS/NIR.

Jack's results showed a phase angle dependence of 20%/25° in MODIS Band 8 (412nm), which were of great interest to several agencies.

Recommendation: Jack Xiong will investigate the phase angle dependence in the MODIS lunar observations together with Tom Stone and report at a Web Meeting.

3l	Application of ROLO model to MSG & MFG	EUMETSAT	Bartolomeo Viticchie
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Bart reported the phase angle dependences observed in comparisons of SEVIRI lunar observations with the ROLO model, which are strong (~10%/90°) for the NIR1.6 channel. Without correcting for this dependence, the drift evaluation for this channel is severely compromised. The drift in the visible channels of Meteosat-7 and MTSAT2 is larger (2.1 and 2.9%/yr, respectively).

Bart identified open issues relating to the phase-angle dependence, which may be addressed with future modifications to the ROLO model, based on PLEIADES data, and the spectral dependence, including the SRF and the interaction with the phase-angle dependence.

The question of whether the phase-angle sensitivity observed at 1.6 μ m is due to the instrument or the model was discussed and may only be resolved by analysing lunar observations from further instruments.

3ma	PLEIADES Lunar observations	CNES	Sophie Lacherade
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Sophie provided an update on the lunar observations from PLEIADES, which now includes more than 1000 images, including intensive observation periods where the Moon is sampled once an orbit. Sophie's analysis is based on the CNES implementation of ROLO (v311g), which has been validated against EUMETSAT's implementation. Her results showed phase-angle dependence, which were consistent between the 4 bands (505, 558, 663 & 844nm): ~4%/90°. The overall uncertainty of the method is estimated to be better than 0.5%.

Sophie also reported the results of an experiment to assess the sensitivity of the lunar orientation. This was very small (0.2-0.6%) and independent of the lunar phase. Sophie suggested this could be due to the polarisation changing.

GSICS acknowledged the great support provided by CNES in the generation and analysis of this unique dataset of lunar observations, which are extremely valuable to develop the lunar calibration method.

3mb	Lunar synergy	CNES	Sophie Lacherade
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The SADE database now include lunar observations from PLEIADES PHR1A, PHR1B, SEVIRI on Meteosat-8 and -9, MODIS on Aqua and Landsat-8. Sophie analysed these to investigate the following application of lunar calibration:

Stability monitoring: good results are already obtained for a limited range of phase angles (<1%).

Inter-band calibration: these are very sensitive to the Apollo correction to ROLO, but less on phase angle and limiting it to $\pm 70^\circ$ is sufficient to give very stable results.

Absolute calibration: Good consistency between MODIS, PHR-1A and -1B when limited to phased angles around 55°: Bias 7-10%. While MSG1 biases 1-3% for VIS0.6 and VIS0.6.

Inter-sensor calibration: Final accuracy of inter-calibration of MODIS-MERIS is $\pm 3\%$, while MSG2-Aqua/MODIS: -7-6% for VIS0.6-0.8 (smaller differences for NIR1.6, but that is strongly dependent on reference band).

What would be the perfect sensor for lunar observations? High spatial resolution, full phase-angle range observable, full spectral coverage 400-2500nm, accurate absolute calibration. No one sensor currently fulfills all these needs. It was pointed out that good polarisation knowledge is also desired, as is SI-traceability in the long-term.

CNES plan to improve the spectral interpolation, fully analyse Landsat-8 and hope to work to improve the ROLO model, based on observations in the SADE database.

There was a discussion of how combining multiple instruments to define a community reference fits with the concept meteorological concept of traceability. Nigel Fox supported this approach as long as a reliable uncertainty can be assigned to the merged reference as it provides a more robust reference in the long-term.

Decision: It was agreed that the definition of merged community references is a good medium-term goal for GSICS - both in the reflected solar band and thermal infrared, as more potential reference instruments are become available.

3n	Using the Moon as Cross-Calibration reference	USGS	Tom Stone
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Tom fitted functions to time series of comparisons of GOES-8 through -13 against ROLO. He suggested this could be validated against vicarious calibration results.

Tom also explained his recommended method of performing spectral interpolation of the ROLO model, which seems to differ in different implementations. He showed an example using ROLO and moon observations to compare the calibration of various MODIS and VIIRS vis/nir bands based on observations, suggesting a relative precision of 1% should be obtainable.

He plans to review the fitting of ROLO measurements to derive the coefficients of the ROLO model, and investigate potential wavelength-dependence of the libration component.

3o	Path towards lunar GEO demo products	All	Discussion
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EUMETSAT offered to provide advice to other GSICS members on implementation of ROLO model. It may also be possible for EUMETSAT to host visitors for short periods to apply the EUMETSAT implementation to their satellite instruments' observations if they are suitably prepared in advance. The idea of EUMETSAT hosting a 1-week lunar calibration workshop to help multiple agencies was discussed. Participation would require preparing a test dataset of lunar observations to a set of specifications: format (e.g. SADE) and list of parameters and best estimate of calibration, example dataset and a document describing how the datasets were prepared. This would need to be reviewed at least 4 weeks before the workshop. These datasets could eventually be shared via the SADE database and used to improve the ROLO model.

This activity could follow the example of the CEOS WG4 on cross-comparison over desert site and solicit interest from other groups.

The possibility of organizing a workshop on lunar calibration was discussed, whose scope would include:

- a) Sharing expertise in the preparation of input data to the reference ROLO model
- b) ... and in the analysis of the output data.
- c) Ensuring the use across all participating teams of the same established version of the ROLO model as implemented by EUMETSAT.
- d) Establishing a common reference archive of lunar observations from all participating instruments.

This workshop would be organized by EUMETSAT in collaboration with CNES, NASA and Tom Stone from USGS. It would be the first step for defining a process to make available to the whole community the latest validated and publically-available version of the ROLO model. EUMETSAT would implement the latest changes and organize the validation of its version of the model with the support of Tom Stone from USGS. EUMETSAT proposed to store a controlled version of its implementation of the ROLO model on its GSICS server, so that it is accessible by the community. It was agreed that USGS will keep the leadership on the scientific developments/improvements of the ROLO model.

Action: EUMETSAT and JMA to prepare a list of requirements to participate in a lunar calibration workshop, applying a common version of the ROLO model and report on timing and feasibility of hosting such an event in time for workshop at a web meeting in May/June 2014.

Web meeting: Feasibility for lunar calibration workshop in May/June 2014.

3p	Rayleigh ATBD for GEO-LEO Inter-calibration	CNES	Bertrand Fougnie
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Bertrand provided a summary of the ATBD proposed by CNES for the inter-calibration of GEO-LEO visible channels over Rayleigh scattering. This is based on a series of stringent selection criteria. The application to older imagers is still limited by the requirement for a NIR band for the turbidity filtering, but early implementation is encouraged in preparation for future imagers. However, it was also noted that omitting this step would not substantially increase the uncertainty for some channels at shorter visible wavelengths. Bertrand also noted that while Rayleigh scattering is an absolute calibration method, knowledge of the underlying mechanism is still limited to ~1%. He is continuing to review the error budget. He showed examples applying the Rayleigh scattering method to inter-calibration and explained why it is not immediately applicable to GEO imagers - particularly due to back-scattering.

Recommendation: CNES to consider extending the error budget to apply the Rayleigh scattering method to bias trending.

3q	FY-3/MERSI degradation monitoring using Pseudo Invariant Calibration Sites	CMA	Ling Wang (Remotely)
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Ling gave this presentation before lunch. She confirmed that need to limit the geometric range of desert sites used to characterise MERSI's calibration to reduce the variability in the results. This was particularly beneficial for the NIR channels (865 and 940nm). The results of FY-3A/MERSI Degradation monitoring using PICS is very similar to other methods such as DCC and multisite calibration.

3r	Spectral Degradation Model of historic GEO imagers	RMIB	Nicolas Clerbaux
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Nicolas presented Ilse Decoster's analysis of the broadband 'visible' channels of Meteosat 2-8, which was performed in support of GERB-like TOA radiances. This work was based on DCCs and fixed locations over land and sea, which were divided into 6 classes, all of which were deseasonalised. She fitted a semi-empirical model of the SRF, with a grey degradation rate superimposed. Her model was validated by analysing the long-term trend on CSR. The major volcanic events were particularly evident in oceanic results for the historic datasets. Other problems include saturation, limitations of 6-bit digitisation and satellite moves. Even taking these into account, Ilse could not find an ageing model to fit Meteosat-2 and -3.

Ilse also found that using Met-8 HRV SRF for Met-7 instead of its nominal values reduced the error on the fit substantially! It was suggested that they have similar SRFs as they are based on similar technology, but Met-7 was not well characterised pre-flight. It may be possible to try the same trick for Met-2 and -3, which goes towards defining a pseudo-channel for FCDRs.

It was pointed out that spectral degradation is typically not linear with wavelength.

Recommendation: EUMETSAT to try using SRF of Met-8/HRV for Met-7 lunar calibration & DCC.

3s	Synergy of methods	CNES	Bertrand Fougnie
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Bertrand discussed the potential advantages in merging multiple (inter-)calibration methods and illustrated this for PARASOL end-of-life recalibration, including Rayleigh, sunglint, clouds and deserts. This provided an extensive dataset to investigate the sensitivity of the calibration to different factors, such as field of view, wavelength, etc. He also showed examples applied to MODIS and SEVIRI.

It was recognised that this approach can provide robust results, applicable over the full range of the datasets, and should be encouraged as an example for future archive re-calibration products.

3t	Next visible products	All	Discussion
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Fangfang described her approach to integrating different calibration methods, with similar levels of uncertainty, as presented at the EUMETSAT Meteorological Satellite Conference in 2013. This assumes that the different methods should converge on the truth and uses recursive filtering to remove outliers.

Web Meeting: to follow up Fangfang's iterative calibration integration method.

GRWG: Extending GEO-LEO IR			Thurs am
Chair: Tim Hewison			

4a	Long-term monitoring of FY-2 and FY-3 IR calibration using GSICS products	CMA	Na Xu (Remotely)
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CMA have recently added CrIS to IASI as a new reference for their inter-comparisons of the IR channels of FY-3 geostationary imagers and FY-2/MERSI and /VIRR.

Na also reported on comparison of the visible channels of FY-3C/MERSI with MODIS using different target types, which generated inconsistent results, which may be due to nonlinearity. She has also used and GOME-2 as an inter-calibration reference for this band. This kind of strong nonlinearity is not seen in the previous FY-3A/3B MERSI.

Na also outlined CMA strategy to use FY-3 instruments to transfer the calibration from the first to second generation of CMA geostationary imagers - and hyperspectral sounders (FY-2 and FY-4, respectively).

Web Meeting: Tim proposed that Na could report in future web meeting on the work they did on the VIS channels using GOME (perhaps with UVSG).

CMA is preparing for submitting an IR product to the GPPA. CMA will report at the next annual meeting.

4b	Implementation of GEO-LEO IR ATBD for	IMD+ISRO	AK Sharmar
4c	India's geostationary satellites		+ P Thapliyal

Pradeep reported on the work done at ISRO on the implementation of the GSICS ATBD at ISRO (references = IASI and AIRS; target instruments: Kalpana/INSAT-3D). He presented, for each main step of the ATBD, the recommended approach and the approach ISRO adopted in order to account for the specificities of their instruments.

The GRWG provided specific advice for tuning the algorithm as follows:

- Alignment in viewing geometry: Tim commented that 0.2 for *max_zen* might be too much (for INSAT-3D sounder).
- Gap filling: Tim recalled that there is a recommended procedure for gap filling. It is available in the ATBD. It makes in particular a difference for the WV channel.
- Uniformity test: ISRO has a slightly different approach wrt the GSICS approach.
- According to the stability of the Kalpana/INSAT-3D the smoothing period can be defined (30 days is just indicative but it can be shorter). The regional meteorological patterns (monsoon) may

impact the way the smoothing window is defined. Pradeep plans to investigate the trade-off between smoothing window, biases due to diurnal temperature cycle, number of collocations and uncertainty.

ISRO plans to have their monitoring results available on their website in about 3-month time and will distribute an announcement to the GSICS Developers' mailing list.

4d	GOES Imager/Sounder IR diurnal variations	NOAA	Fangfang Yu
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Fangfang reported on the midnight calibration issue + characterization of the diurnal calibration variation for GOES IR.

The midnight calibration anomaly is thought to be caused by extra radiation reflected by the non-unity emissivity of the BB to the detectors when the instrument is viewing the BB + scattered solar radiation contamination in space (known since 1996, Johnson and Weinreb). All 3-axis stabilized GEOs are affected by the problem. In operations, there is a correction (empirical) (MBCC).

For GEO-LEO inter-calibration, the reference instruments are IASI and AIRS. The difference between the radiometric calibration of these references is very small. The correction algorithm (MBCC) is activated independently for each channel. Diurnal variation changes from channel to channel and for different seasons. Uncertainties are provided to the users but they cannot reach the same accuracy than at day time.

Fangfang presented also the approach and some results for GEO-GEO IR inter-calibration (GOES-13 and GOES-15). In particular, results on the latitudinal distribution of the mean GEO-GEO Tb difference were shown. Some channel exhibit significant trending.

For GEO-GEO product there are some new challenges to tackle: different SRFs, possible latitude dependent biases,

Regarding diurnal variations, the variation in the daily calibration is higher than the uncertainties stated for the inter-calibration. Users should be made aware of that.

Decision: The diurnal calibration variation should be provided in GEO-LEO IR products before promotion to operational status.

Recommendation for EUMETSAT to use analysis done by Fangfang, quantify the diurnal variations on a monthly basis.

Action: Fangfang Yu to propose what the variables should be in the netCDF file to provide information on the calibration diurnal variation, and report to GRWG.

4e	GEO-GEO products - diurnal variations	EUMETSAT	Tim Hewison
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Tim reported on EUMETSAT results regarding GEO-GEO products, using MSG1 and 3. Due to RSS sensing mode, many collocations are over land. IASI observations are used to make the spectral conversion. One-day results: small diurnal cycles are observed either for standard scenes or for cold scenes. For the latter, the diurnal variation is more pronounced. But the results vary from day to day. Monthly-accumulated results: small variations are observed. However, they are larger than the uncertainties quoted by the GSICS method.

Questions:

1. What needs to be done for GEO-GEO IR products? Are further developments needed?
2. Who would need such products?

Tim does not see a need for a GEO-GEO IR product. Fangfang and Fred have the same opinion. Fangfang pointed out that while GEO-GEO can be done 24h a day, GEO-LEO is more accurate. However, one possible application could be real-time application and calibration alerts when one instrument calibration is departing from usual behaviour.

Tim pointed out that the development activities on GEO-GEO IR products clearly need to be thought again when GEO hyperspectral instruments will be available.

Action: CMA and JMA to present their analysis on GEO-GEO IR products at the next meeting.

Action: CMA invited to present plans for developing inter-calibration products for GEO hyperspectral IR sounder

Action: EUMETSAT to provide support to CMA on navigation of the MSG satellites as requested.

4f	MetopA/IASI-MetopB/IASI differences	CNES	Denis Jouglet
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IASI accuracy overwhelms the RTM capabilities in term of absolute accuracy.

The methodology for inter-comparing hyperspectral sounders was presented, together with a series of intercomparisons: IASI-A / IASI-B, IASI-A/AIRS, IASI-B/AIRS, IASI-A/CRIS, IASI-B/CRIS (for nominal quality operational data as provided by EUMETSAT). This tool is operational.

CNES has also performed a new spectral inter-comparison between IASI-A and IASI-B.

Very accurate cross calibration for IASI-A/CRIS, and IASI-B/CRIS. Same for IASI-A/AIRS, IASI-B/AIRS. The various biases (direct comparisons and double differences) are consistent with each other.

Denis also presented the activities performed by LMD on the assessment of the calibration accuracy of IASI, using NWP data and double-differencing. Results are consistent with CNES results.

General comments: members of the GRWG are welcome to invite expert partners from other groups (universities, labs, etc.) they have collaborations with.

4g	Delta Correction format for embedding in netCDF GSICS Corrections	EUMETSAT	Tim Hewison
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The delta correction method was described in previous meetings. It was agreed to generate these corrections even though they are not GSICS products on their own rights. Even if the delta corrections end up being small, they must still be generated.

Tim did not find any significant difference between IASI-A and -B in SEVIRI channel space - either for warm "standard radiance" scenes or cold scenes. These results appear to be inconsistent with the small changes reported by CNES.

Action: Tim Hewison to send CNES example GSICS Corrections with embedded delta corrections for further analysis.

Tim presented the uncertainty analysis performed for the delta correction method. He raised the question on what should be done after IASI-A stops. Jack suggested to use CrIS to fill the gap with Metop-C. A two-year overlap is needed for the being able to extrapolate the uncertainties.

Generation of delta corrections:

1. Do we use same delta corrections for NRTC and RAC?
NO
2. What smoothing period to use for delta corrections?
As for NRTC and RAC products (e.g. 14d and 29d).
(Post-meeting note: This decision was revoked at the [web meeting](#) of 2014-05-27.)
For reprocessing activities, the question should be raised again.
3. What happens if IASI-A dies?
We should remove the delta-correction when the second instrument is not available anymore (Manik)
A backward compatibility is needed for current IASI-A products (Tim)
4. Do we really need another class of GSICS product? ⇒ referring to archive reprocessing
5. How to distribute embedded delta corrections? ⇒ 4 options were proposed. Option C is the preference but we could start with Option A and add info later on. Fangfang suggested to ask users for feedback.

Action: GCC need to identify a user for advice on preferred format for delta correction.

Nigel Fox proposed collaboration with GSICS to help defining ways of propagating uncertainties.

4h	Promotion to Operational status - review user guidance	All	Discussion
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Delta corrections: ready to go. But the files should include info on diurnal variations

Correct Aqua/AIRS to IASI-A should be done. It is difficult for JMA to commit due to resources limitations.

Action: EUMETSAT to implement the delta corrections in GSICS products using Metop-B/IASI.

Recommendation: JMA to investigate the possibility of correcting Aqua/AIRS to IASI-A as a delta correction.

GEO-LEO IR should start moving operational this year!

Decision: One aspect of the GPPA review process was clarified: in case of equivalent products for instruments of the same series, the product generator should still complete the GPPA form. The GCC should pass this to reviewers, highlighting any differences from previous implementations. Reviewers could give their consent for more than one product at once unless a specific review is required. In the case no response is received before the specified deadline, promotion can continue.

4i	Plotting Tool Roll-out	All	Discussion
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This was not discussed, as the situation has not changed since the last annual meeting. However, EUMETSAT expect to release an operational implementation of the tool soon.

GRWG: Microwave Subgroup	Thurs pm
Chair: Cheng-Zhi Zou	

This session was conducted by Webex. Participants included Cheng-Zhi Zou, Xiaolong Dong, Ken Holmlund, Li Hang, Qifeng Lu, Ralph Ferraro, Tiger Yang, Wenze Yang, Sreerekha Thonipparambil, Sabatino Di Michele, Pradeep Thapliyal (ISRO) and Tim Hewison, and Keita Hosaka (JMA).

5a	CEOS WGCV Microwave Sensors Subgroup-objectives and activities	CAS/NSSC	Xiaolong Dong (Remotely)
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Xiaolong introduced the Microwave Sub-Group of the CEOS Working Group on Cal/Val, its mission, objectives and activities and interaction with other groups. He clarified that the group covers both passive and active instruments, but does not include SAR, which has another sub-group. He also clarified that the group have started to think about coordination of transponders between the different agencies.

5b	FY-3 Microwave Sensor Status and Calibration	CMA/NSMC	Qifeng Lu/ Songyan Gu (Remotely)
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Qifeng introduced the MWTS on FY-3 satellites and explained how the bias was monitored used NWP+RTM. He described how double differencing with NWP models has been used to optimise the non-linearity of MWTS.

Tim Hewison asked the group about the potential to develop NWP DD method into GSICS inter-calibration products in the future. Cheng-Zhi replied that this is something for the group to think about in the future - although he didn't have experience with this method himself.

5c	AMSU/HMS inter-calibration and its relevant hydrological products	NOAA	Ralph Ferraro (Remotely)
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Ralph outlined his project to characterise the window channels of microwave sounders used to generate humidity, cloud and precipitation products for hydrological applications. His aim is to make homogeneous time series from which L2 products can be derived as NOAA TCDRs and FCDRs. Ralph summarised the key findings :

- AMSU-A/AMSU-B/MHS can have significant geolocation errors, which can be more severe in a particular satellite or time period (NOAA-15 AMSU-A2 was the most problematic).
- AMSU-A/AMSU-B/MHS can have significant cross scan biases (NOAA-15 AMSU-A and Metop-A MHS were the most severe)
- Several AMSU-B sensors show degradation over time (NOAA-16 AMSU-B channel 5 has the largest degradation)
- Multiple calibration methods are required to generate CDR's for AMSU window and water vapor channels (e.g., SNO, vicarious calibration, etc.)
- Bias is often scene temperature and/or polarization dependent
- Warm target contamination caused by orbital drift is one of the most important error sources for inter-satellite calibration

v1 AMSU-A FCDRs are being finalised.

AMSU-b/MHS are still under development. v1 products should be available in summer 2014.

Ralph confirmed that the channel differences between instruments were not significant - except for the 150/157GHz channel, for which no transformation is applied. Users need to account for each instruments' SRF when retrieving L2 products.

5d	Inter-calibrated MSU/AMSU level-1c radiances going GSICS pre-operational phase	NOAA	Cheng-Zhi Zou (Remotely)
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Cheng-Zhi described an extended analysis of microwave sounder biases, using an integrated method, which is not just based on SNO, but also global ocean means, RTMs, etc. Biases were classified into 5 types, with different characteristics and different underlying causes.

Plans for FCDR data production were outlined, including a reprocessing of L1b data using new calibration coefficients to generate a new set of L1c radiances for all channels, with QC inherited from the L1b data. The new BT datasets for AMSU and MSU and associated documentation are distributed through NCDC. The AMSU data is updated monthly.

Cheng-Zhi compared and contrasted this work with the frequency shifts described by Qifeng below ([5e](#)). These use different assumptions to explain the observed patterns of biases. He plans to collaborate between CMA and NOAA to repeat the frequency shift analysis. He also suggested some of the observed biases may be caused by pressure errors in the radiosondes assimilated into the NWP models.

Recommendation: Cheng-Zhi Zou to provide Tim Hewison with information on potential radiosonde pressure errors to be followed-up at GSICS-GRUAN-GNSRO workshop in May 2014. (Done by email 2014-04-03, which referenced Stauffer *et al.*, 2014, who showed errors of ~0.5hPa for the RS92 and ~2hPa for other sensors. These are not sufficient to explain the biases reported above.)

Differences may be resolved by analysing synthetic datasets, with imperfections introduced.

5e	Potential frequency shift in MSU/AMSU observations	CMA/NSMC	Qifeng Lu (Remotely)
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Qifeng described an investigation of applying various frequency shifts to AMSU-A different channels of NOAA-15 to -19, Metop-A and Aqua prior in comparison with NWP+RTM models. .

This again demonstrated the power of NWP+RTM as a tool to analyse the calibration of these channels.

5f	Progress towards Demonstration Products	All	Discussion
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Nothing further was discussed due to time and technology limitations.

GRWG: Future IR Products			Thurs pm
Chair: Tim Hewison			

7a	Retrieval of SRFs from hyperspectral inter-calibration	NOAA	Manik Bali
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Manik described a method to retrieve the SRF of a broadband IR instrument by comparison with a hyperspectral reference instrument. He showed examples for the 11 μ m channel of AATSR, using 2 years of collocations with IASI.

It was agreed that this is a very promising technique, which has potential to become a GSICS product in its own right, and can be evaluated from the hyperspectral intermediate datasets already generated as part of the GSICS GEO-LEO IR inter-calibration process.

Tim pointed out the current inversion method includes several implicit constraints, which introduced a priori information. This is needed to stabilise the inversion process - for example, introducing the assumption of smooth radiance dependence, and smooth SRFs.

Tim also suggested that Manik formulate the retrieval as a variational method to optimally account for the uncertainties. This approach has the advantage of generating uncertainties in the retrieved SRFs.

It was suggested that there may not be enough spectral information in the window channel to give reliable results. Channels close to spectral lines have more information content, so it was encouraged that these are investigated first.

Recommendation: Manik Bali to investigate a variational approach to the SRF retrieval problem and report example application to a non-window channel, including uncertainties, at the next annual GRWG meeting.

7b	IASI-CrIS comparison & Tool	EUMETSAT	Bertrand Theodore
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Bertrand described a series of comparisons that are routinely conducted at EUMETSAT as part of the instrument monitoring activities. These include IASI, HIRS and CrIS. A method was described to transform the IASI and CrIS observations to comparable channels. These channels were then compared using SNO and NWP+RTM double-difference methods.

SNO results show CrIS is warmer (~0.1K) than both IASIs at the long-wavelengths, which may be due to non-linearity effect in these CrIS channels.

NWP+RTM results required stringent restrictions (including limiting the O-B at 11µm) to generate reliable results.

Neither method showed significant differences between IASI-A and -B in the 11µm window region.

Action: CNES and EUMETSAT to investigate differences in their IASI-A, -B and CrIS comparison methods and results, and report these by the next annual GRWG meeting.

7c	Minimising SBAF Uncertainty - using AIRS to bridge HIRS/2-IASI gap	EUMETSAT	Tim for Viju John
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Tim outlined the outstanding question of how to handle the IR8.7 channel in MSG and suggested the equivalent channel of HIRS/3 could be used. This would require building a blended reference as a composite of AIRS and HIRS/3 instruments. This refers back to earlier discussions of this topic in the frame of Archive Re-Calibration products.

7d	Progress with MICROS Radiance Monitoring for inter-calibration	NOAA	XingMing Liang
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XingMing explained that MICROS Double Differences can be used for cross-platform consistency, assuming the NWP+RTM errors cancel out, as it is effective at minimizing the effect of systematic errors and instabilities in BTs.

New results include AVHRR re-processing, which are currently limited to night-time only data. The results show Metop-A/ and NOAA-17/ AVHRR are the most stable, so are used as references, which may be due to stability of orbit.

The use of ECMWF fields to improve background compared to GFS, and reduced the mean O-B significantly, and sensitivity to variables, such as wind speed, but not the variance. The variances of the

Double Differences, however, showed small but significant improvements when changing from GFS to ECMWF.

XingMing also expressed a desire to cooperate more closely with GSICS and to process GEO data and use hyperspectral instruments as a reference for the double difference inter-calibration. Tim suggested that this will allow consolidation with SNO-based inter-calibration, noting it would be fantastic for GSICS.

MICROS may also include RTTOV in the future, which may be helpful for RSB channels, which they also plan to include. This would allow the validation of the assumption that the systematic errors from RTM as well as the NWP model are fully cancelled out.

7e	Progress towards Demonstration Products	All	Discussion
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The groups discussed how to lead development of NWP+RTM DD products in GSICS. This could be done through IRSG or new SG. NOAA/NESDIS/STAR would be interested in leading a sub-group on the use of synthetic observations as an inter-calibration tool

Action: XingMing Liang to report the requirement from GSICS to support MICROS.

Action: GRWG Chair to investigate the possibility to form a sub-group to develop inter-calibration products based on double difference comparisons with model data (NWP/RAOB+RTM).

Action: CMA to provide ATBD for FY-3C IR product

Action: EUMETSAT to report the AVHRR-IASI inter-calibration work in next meeting

GRWG: UV Subgroup		Thurs
Chair: Lawrence Flynn		pm

6a	Selection of Chair and Vice Chair Introduction of four Projects	NOAA	Lawrence Flynn
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Rose Munro has been nominated by two suggestions as chair, and Larry Flynn was nominated as vice-chair. Both were approved by consensus vote.

6b	Overview of ESA Activities	ESA	Bojan Bojkov
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This presentation was not delivered, as Bojan was unable to attend.

6c	Instrument On-Ground and In-Orbit Calibration – Lessons learnt	EUMETSAT	Ruediger Lang
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Ruediger presented some example from recent on-ground calibration campaigns showing that desired target levels of 1% radiometric accuracies are often not achieved during the dedicated calibration campaign because of the lack of time, resources and accurate commissioning of sources and control of equipment (like thermal and vacuum control). In order to achieve the from this community required sub percentage accuracies the community would need:

- i) better characterized and performing sources (e.g., tunable Lasers)
- ii) Better vacuum chambers where angular measurements can be carried out with very well controlled thermal environment.
- iii) Well controlled active thermal control of the full optical bench of the instrument.
- iv) More time for preparation and execution (including exercises) of campaigns.

The subsequent discussion on how to achieve sub-percentage accuracies in the lab agreed that this would only be possible by a cross-programme and/or cross-agency effort on the matter, i.e. investing in fundamental improvements in equipment and sources at various sites.

6d	Solar References and Variability Presentations	NASA/SSAI	Matt Deland (Remotely)
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To cover the full range for the irradiance spectrum, various instruments have to be used which may even measure at different times with different band passes etc. Matt introduced various reference spectra like Dobber et al. or Chance (SAO) et al from OMI and Kitt Peak, ATLAS-1/3 (Thullier) and WHI (Woods et al.).

Important issues to deal with: resolution and sampling rate. Both sampling and actual resolution are important for comparisons. Larger bandpass filters provide better results in the inter-comparison. In the UV 150 to 300 nm even broadly smoothed differences often exceed the quoted accuracies (more than 10% at times). Below 290 nm, the latter may partly due to the solar cycle and activity, i.e. it is important when the measurement has been made. Suggestion to use Mg-II index proxies to compare and use wavelength-dependent scaling factor. The patterns of spectral variations are very similar both over full solar cycles and for solar rotations during active periods. Discussion on where and by how much the solar irradiance deviates from the simple black body law. OMI long term variations over a complete solar cycle are very similar to shorter term variations. Higher spectral resolution measurements like from GOME-2 gives you also larger variability at the Fraunhofer lines. The large differences in Mg-II index levels for various instruments exhibits a relationship with spectral resolution, which can be derived from their bandpasses. This can be used to generate scaling factors for Mg II index composites and predict the solar activity variations for a given instrument.

6e	Reflectivity and Aerosol Index Presentations		TDB
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No presentation was available on this topic. After the session, Matthijs presented some results tracking the Aerosol Index for GOME-2 over time. The analysis captures the time-dependent change of the wavelength pair used to create the index. Larry presented some cross-track aerosol index monitoring plots for OMPS. Larry also presented cross-track evaluation of minimum reflectivities and aerosol index over time.

6f	Ozone Profile Retrieval Presentations	NOAA	Lawrence Flynn
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Measurement residuals between different wavelengths can be compared by using radiative transfer calculations for different viewing and SZA geometry accounting for the contribution functions of the ozone profile. Even when using a simple climatology two instrument should show the same measurement residual responses at SNOs or no-local-time difference latitudes. Various comparisons have been made between SBUVs on different platforms, as well as OMI/GOME-2 and OMPS/GOME-2.

Measurement differences between two instruments can be translated with an optimal estimation approach into ozone profile differences or vice versa. Latitude can be selected to that there are no local time differences for a pair of ascending and descending platforms. This allows comparison of zonal means with the effects of diurnal variations. Generally relative differences in the ozone profile can be identified on the order of 2%.

GDWG	Wed am
Chair: Manik Bali	

Attendees: Manik Bali, A.K. Sharma, Masaya Takahashi, Byung-II Lee, Peter Miu, Pablo Benedicto (part time), Simon Elliott (part time), Scott (part time), Larry (part time).

8a	Introduction and Breakout Session Agenda	NOAA	Manik Bali
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Manik provided an overview of the GDWG. He laid the following items on the table for discussion among members.

1. **GDWG resources.**
2. **GSICS data filenaming conventions, file formats, metadata. Taxonomy (Discussed in progress made by NOAA GDWG)**
3. **DOI/OID Number (Discussion with members including Simon Elliott)**
4. **Progress in GDWG made by members organizations.**
5. **Event logging, Data Archiving.**
6. **GDWG developed bias monitoring tool. (Peter Miu presentation)**
7. **GPPA (Presentation by Peter Miu)**
8. **Big Data, how can we benefit from it.**

GDWG Resources

It was identified that there is a lack of resources in the GDWG and this needs to be discussed with the Executive Panel. This is an urgent issue which has been brought up many times with no resolution.

Essentially, if GDWG is expected to provide further deliverables, each GPRC MUST provide a GDWG member to the joint meeting as well as web meetings. He/She must provide technical support to the agreed tasks. The Executive Panel needs to URGENTLY and SERIOUSLY resolve this.

Action: As in the case of the WMO expert teams, The GSICS Executive Panel Chair shall write to the GPRCs to confirm the committed availability of the proposed GSICS working group members required to complete the tasks assigned to him/her. For example the commitments might be:

- Working Group Chairs - about 20 days a year.
- GRWG/GDWG member - about 15-20 days a year.

Action: IMD confirmed they will search in IMD for a technical person to support the work of GDWG.

For this year, Manik has kindly taken the role of the interim GDWG chair after Aleksander's departure. Masaya (vice chair) has clarified that his workload for 2014 is too much for taking on the chair responsibilities but he will take up the GDWG chair in 2015. Peter nominated himself as for the new vice chair role to support Masaya and requested other attendees to also provide a candidate if possible.

A.K.Sharma also nominated himself as vice chair, he is also on the Executive Panel. The validity of this nomination needs to be clarified but a IMD vice chair is welcome.

Recommendation to EP: The GDWG accepts this schedule and the vice chair nominations.

8b	Taxonomy of GSICS Products	NOAA	Manik Bali
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This addresses the THREDDS data tree configured on the GSICS collaboration servers. It can be address further in Emails and a web meeting.

Action: GDWG shall have a THREDDS configuration web meeting in July.

8c	NOAA GDWG Activity Progress Report	NOAA	Manik Bali
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Manik Bali gave the presentation on progress made by NOAA GDWG in the past year. He presented Aleksander's work on Taxonomy, netCDF File content organization, CF convention submission, Schema for exchanging event logs. Manik Bali also mentioned that one of the accomplishments of the GDWG (with Aleksandar as chair) was its support in the acceptance and progress of AMSU/MSU product (to Pre-Op). As per GPPA procedure GRWG and GDWG chair had to give consent for the product's progress in the GPPA, which was obtained during this process. At this point GDWG member Peter Miu and Masaya Takahashi pointed out that they were not aware of the details of the procedure that was followed to accept the product.

The file-naming convention was then discussed in the context of the NCDG AMSU/MSU FCDR which NOAA have submitted as a GSICS product. Some members (EUMETSAT and JMA) felt they had not been adequately consulted during this GPPA submission process and pointed out that it is incompatible with the GSICS collaboration servers. As GCC Manik Bali informed that a new website is being made to make communications within GSICS transparent in order to avoid such discontinuities in the future.

On his part the then GDWG Chair Aleksandar had also requested NCDG to change their filename convention but they replied in the negative. Rest of the GPPA procedures were followed and concerned email has been shared with EUMETSAT. In order to avoid such conflicts members agreed to modify the GPPA exceptional handling and making it web-based, as new products are in the offing.

DOI/OID Number

The group discussed DOIs (Digital Object Identifiers) in the context of assigning them to GSICS products. The NOAA library has provided the GCC with DOI numbers for the GSICS newsletters. This service could be used to provide DOI numbers to GSICS products provided the meaning of the DOI numbers is known.

Decision: GSICS products shall have a persistent identifier using a standard like DOI or OID (Object Identifier). This will allows them to be uniquely identified and referenced.

Recommendation: GDWG to research NOAA DOI meaning and revisit this discussion in a web meeting.

Action: GDWG shall have a DOI/OID web meeting in May/June.

Progress in GDWG made by members' organizations.

8d	CMA GDWG Activity Progress Report	CMA	Scott Hu
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Scott showed the new GSICS website. The links from the WMO website needs to be updated for this and Scott will organise this with the WMO. He demonstrated the capabilities on the website showing various FY2 and FY3 instrument information, and the bias monitoring plots between FY2 VISSR against Metop IASI.

He also displayed links to access the data. The CMA GSICS server hardware is available but there are some issues with the installation of the software. Peter offered support for the installation of the software (THREDDS) and the initial configuration..

Action: Scott Hu (CMA) to double check that access to Webex and Google document is available from China to support GSICS activities.

CMA plans to provide GSICS products this year and KMA also plans to provide these products.

CMA has confirmed that they has a candidate for a full time GDWG member.

Action: Scott Hu (CMA) to provide WMO and GDWG with the name of the CMA GDWG member.

8e	JMA GDWG Activity Progress Report	JMA	Masaya Takahashi
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JMA has made updates to the GSICS website names, they will inform the WMO and necessary users on this.

JMA plans to automate the logging of satellite events.

JMA appreciates the EUMETSAT product checking tool to visualise and validate the JMA GSICS product contents.

JMA took an action to investigate how the GSICS product catalogue can be made discoverable in WIS. There is some confusion from the groups on whether the GSICS product catalogue is registered there or the products in the catalogue are to be registered.

IMD is interested in receiving GSICS products on the GTS. Simon explained that the WIS and the GIS are used by the World Weather Watch. This means GSICS products do not fit in this user community and it is not the right place for GSICS products. In addition to this, the GTS has small bandwidth, sending products to the GTS is not easy and the GTS does not understand netCDF.

JMA suggested, we register the catalogue with OSCAR and this is agreed by the group. JMA action is now closed.

Action: GCC to coordinate with WMO to add GSICS products catalogue to WMO OSCAR database.

NetCDF metadata checker needs to be updated to support current and future products. The group needs to decide how to maintain this tool as it is not part of the GCC (see later action).

JMA is requesting updates to the bias plotting tool to support new products (see below).

8f	KMA GDWG Activity Progress Report	KMA	Byung-II Lee
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Show GEO-LEO-IR product information, KMA is following the agreed standard in developing this product. KMA will work with JMA on the data names and formats.

There are many KMA website updates to provide information GSICS and their products. They have also developed a bias monitoring web page.

KMA with the help of JMA are encouraged to upload their products to one of the GSICS collaboration servers.

Action: KMA to provide GCC with links to GEO-LEO-IR data and products for inclusion into the product catalogue.

Action: KMA to send products to the EUMETSAT GSICS Data and Products server until the CMA collaboration server is available.

8g	Calibration Change Alerts	EUMETSAT	Peter Miu
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The presentation addresses the request from the GRWG on how calibration alerts can be sent to the alerts. Active and passive implementation were shown, as well as the importance of sharing the work amongst the GPRCs.

JMA states that the GSICS User Messaging Service is enough at present. The rest of the group agrees for the current users although the limitations are known thus this calibration change alerts may be readdressed in the future.

NOAA suggested that the ICVS tool at NOAA can be used for a calibration alert system.

Recommendation: When a dedicated Calibration Change Alert is needed, NOAA shall coordinate a web meeting to demonstrate how ICVS can be used for the implementation of such a system.

Recommendation: Alternatively, EUMETSAT to investigate the use of the bias plotting tool to generate calibration alerts through the analysis of the GSICS products.

8h	Big Data..new Approach	NOAA	Laurie Rokke
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The presentation provided a simple and understandable overview of what Big Data is and how it is used.

Google initially implementation BIG data concept, and the NIST is developing standards for big data and anyone can be involved in this technologies.

Essentially big data is creating programs that can be broken up and process on different “nodes” to improve processing performance. In addition to this, it is available for machine learning of the data to provide interesting and important analysis of the data.

This technology is of interest although some time is needed to identify where this technology can be used for in GSICS. Tentative ideas discussed by the group are in the area of generate co-location intermediate files and generating calibration alert from plotting tool for GSICS product as these become larger.

Example of Big Data usage are Amazon, Facebook and earthcube.org (US gave 20 billion to build this big data website for storing DATA).

Recommendation: The GDWG members are strongly encouraged to work with their GRWG to explore how Big Data technology can be applied to GSICS activities, and discussed them in a future web meeting.

8i	Discussion		All
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Done.

8j	GSICS Products Archiving Process	EUMETSAT	Peter Miu
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The presentation discusses a proposed process for archiving GSICS products. Basically the GRWG shall provide a formal request to justify the needed to archive due to cost issues. The GDWG shall discuss the request and decide if it can be satisfied. The presentation provides the details of this process. The group agrees that this is needed to support GPRC enhancement processes for archiving new data sets.

Action: EUMETSAT shall provide a method to formalise this process in an automated way (if possible).

8k	Requirements for Instrument Event Logs		Rob Roebeling
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GPRCs have event logging information on their websites and a simple approach shall be taken to make them accessible by the user community. Once this is established, further enhancements will be introduced when GRWG/GDWG resources become available

Action: All GPRCs to respond to CGMS-41: WGII/3 Action 41.22: "CGMS agencies to provide working papers on current and future capabilities for calibration monitoring and event logs – CGMS-42."
(Already closed)

Action: All GPRCs to provide satellite instrument specific links to calibration events to WMO-OSCAR.

Action: All GPRC to seek consensus on common naming conventions for calibration events at the level of Main-Categories/Sub-Categories/Event Types.

Action: EUMETSAT/NOAA/NASA/JMA to define a calibration events database design, and if needed, discuss this in a future web meeting.

Recommendation: All GPRCs to review the calibration events database design, and to test the robustness of the proposed design through a pilot study, and report their findings to the GDWG.

Action: EUMETSAT to keep in contact with WMO on adopting OSCAR to include links to instrument events web-pages.

Recommendation: all GPRC to assess if history events can be made available and report this in the next GSICS joint meeting.

Note: IMD indicated that it is possible for them to a generic event log database. Some work is needed first in defining requirements (ATBD) and provide a technical design of such a system.

8l	Discussion on Requirements		All
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Done.

8m	Instrument Event Logs Implementation plan		
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Done.

8o	GDWG Action Items review		All
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The group reviewed the GDWG open action items.

Action: All GPRCs to review their GSICS websites to take into account of the new developments in GSICS as these websites will be reviewed in the next joint meeting.

Action: IMD to update their website to provide GSICS information. This will be provided on the WMO for inclusion into their website.

Action: Masaya Takahashi to check for a document regarding minimum content for GPRC GSICS webpage. If this document does not exist, then he shall author one and upload it to the Wiki.

Some actions have been closed due to a lack of resources. (See [GSICS Wiki](#) for details).

Action: EUMETSAT to support the creation of a GitHub account for uploading the GSICS related codes for collaboration development.

Action: GCC to upload the netCDF checker to the GitHub account.

Action: GCC to update Taxonomy information to the Wiki or GCC website.

8p	Proposed GPPA Improvements	EUMETSAT	Peter Miu
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Action: GPRCs are invited to clearly nominate their member for the GPAT. The GPAT member should promptly coordinate the review of the GSICS products before operations. This information will be presented into the GCC website.

Action: EUMETSAT to prepare a proposal for automating the GPPA and demonstrate this in a web meeting.

Action: GCC to take a lead in discussing the GPPA with GSICS members to reduce the amount of time needed to move through the phases.

8q	GEO-LEO product promotion	NOAA	Manik Bali
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The promotion of the GEO-LEO IR product was discussed in the GRWG break out session. We have the following roadmap in the coming year.

- GOES13-IASI product would be evaluated for promotion to op status. Fangfang has submitted petition.
- GOES15-IASI product needs reviewer comments.
- Meteosat-IASI product would fulfil operational requirements after migration to new EUMETSAT building is completed

8r	Preparation for 2014 Users' Workshop		All
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Action: GCC will discuss with GPRCs to prepare for the GSICS user conference 2014 to promote the GSICS products.

8s	GDWG Roadmap to 2014 (and beyond)		All
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2013 Roadmap was discussed.

Action: GCC shall take a look at WMO/CGMS documents to prepare templates for GSICS documents and provide these to the GDWG for discussion.

Action: GCC shall provide a Document Management Plan (for example NOAAs) to the GDWG so that GSICS has a framework to publish documents.

Road Map for 2014

- Collaboration server shall start to synchronise their GSICS products with each other.
- Satellite Instrument Event Logging specification, design and implementation.
- Process for archiving GSICS products.
- Implementing new capabilities in the GSICS product plotting tool.
- GSICS document management plan definition and associated document templates.
- Investigate using Big Data in GSICS activities.

Note to the Executive Panel, there will be little or no progress to any item on the Road Map if there are not enough resources and GDWG/GRWG members do not commit time to their assigned tasks.

8t	Follow-up on netCDF format for DCC & Delta Corrections		All
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This topic was addressed in the GRWG (agenda item [4g](#)).

8u	Updates to the CF Convention	EUMETSAT	Peter Miu
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Briefing on what the problem is: it's difficult to come to a consensus for standard names and units used.

Recommendation: GDWG shall support the development of the CF convention and provide input to the CF governance committee. This can be done using Webex or in the joint meeting.

Plenary - Wrap-up			Fri am
Chair: Tim Hewison			

9a	GRWG Summary & Agree Actions		Tim Hewison
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Recommendation: CMA and EUMETSAT (Xu Na and Ruediger Lang) to investigate and report on the stability of the GOME-2 dataset with respect to Aqua/MODIS

Action: Xu Na (CMA): report at the next meeting on the work done on SRF retrieval using hyperspectral instruments.

Action: EUMETSAT to share with IMD plans for reprocessing of the archive data (re-calibration)

9b	GDWG Summary & Agree Actions		Manik Bali
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In this presentation the summary of GDWG discussions were presented. These are:

- Wiki has been updated on the status of the actions. 24 actions were closed. Still 2 actions are opened.
- Main topics addressed: GPRC reports, calibration change alerts, big data (advanced technique for managing processes and data manipulation), GSICS archive process, and calibration event logging database.
- Improvements to the GPPA were proposed.
- IMD will identify a representative to be part of the GDWG.

- There are some issues with the current GSICS wiki. However, the GDWG did not discuss about relocation or changes as the current infrastructure contains a lot of information and a change would require a substantial effort.
- GDWG members from each agency need to harmonize their contribution towards the group. At least 15-20 days of work for each GDWG member is required (as per a WMO memo available with Simon Elliot). GDWG will write a proposal to the GSICS Executive panel to send a letter to each GPRC to follow WMO recommendations on time allocation for people providing support to international projects endorsed by WMO.
- Calibration Change Alert: GSICS User Messaging System is currently enough for diffusing the Calibration Change Alerts.
- The plotting tool could be extended if needed to generate alerts using its own internal analysis (through a regular check on the variability of the ingested data).
- Members of the GRWG are invited by the GDWG to look at the presentation on Big Data to have an overview on the possibilities offered by such technologies (available on the Wiki)
- Collaboration servers shall start synchronize their GSICS products with each other: KMA, JMA and CMA will first use EUMETSAT server. It will be extended as soon as CMA server is up and running.

9c	VIS/NIR Sub-Group Summary & Actions		Dave Doelling
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EUMETSAT and JMA will formulate a strawman product to be distributed before a web meeting. For GOES, there is no possibility to provide the space count offset. Version control must be in place for traceability.

Recommendation: CNES to provide a BRDF model over land for Meteosat.

Action: EUMETSAT to provide feedback at web meeting on how to handle DCC seasonality by Oct 2014.

Action: EUMETSAT/NOAA/NASA/JMA to perform analysis to evaluate the optimal temporal resolution for a DCC product. GPRCs are invited to report at the next web-meeting on the DCC method.

Next DCC web meeting will address seasonality. Further meeting will address DCC product format and plots for bias monitoring.

A web meeting will address the topic of combining methods.

Action: Dave Doelling to provide all GPRCs with a survey to prepare the path forward on calibration methods (other than DCC and lunar methods). Nigel Fox will liaise with CEOS-IVOS on this topic. The outcome of the survey will be discussed at a web meeting.

CMA raised the point that lunar orbiter imagery can be used for characterizing the Moon. Tom stated that the amount of resources required is large and cannot be achieved at USGS but supported CMA to invest in that activity. Dave mentioned that it can be taken onboard later on as part of possible improvements.

9d	UV Sub-Group Summary & Actions		Larry Flynn
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GSICS UV subgroup to interact with CEOS-IVOS on the solar irradiance spectrum.

Larry mentioned the coming launch of the EIPC instrument in 2015. It has the capability to observe the Moon and as it extends up to 779nm it increases potential for inter-calibration.

9e	Microwave Sub-Group Summary & Actions		Tim for Cheng-Zhi Zou
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Tim presented an overview of the presentations delivered during the microwave sub-group session. Although there were no specific actions generated in the meeting, there were interesting discussions on the potential use of NWP+RTM bias monitoring as an inter-calibration tool, and how to resolve the different interpretations of the observed biases in microwave sounders. These discussions will be followed up in future web meetings.

9f	GSICS-WGCV IVOS Interaction		Nigel Fox
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Nigel recognised the successes of GSICS and expressed a desire to achieve similar results from IVOS.

He identified the following areas for potential interactions between the groups:

- Deserts (PICS) methods for cross- comparisons (Vis and IR)
- Moon as a calibration reference - improved models and usage
- LEO – LEO cross-calibration methods in general
- Cross-comparison tools and databases and results
- Pre-flight calibration workshop
- Use of atmospheric hyperspectral imagers for band to band correction
- Reference solar Irradiance spectrum and methods to convolve with instrument bands
- IVOS to make more visible its activities through GSICS newsletters
- Request examples of Cal/Val best practise following QA4EO principles as case studies
- Efforts to establish SI Traceable Climate and calibration sat in space
- Many overlaps of personnel perhaps some joint co-located meetings
- Assume that surface measured test-sites and associated in-situ / cross comparisons is of supporting interest to GSICS
- Contribution to survey on Cal/val methods: activities/priorities

Action: GCC and Tim Hewison to follow up on the support to CEOS WGCV regarding the GPPA as an example for best practises for QA4EO - after reviewing at web meeting in Summer 2014.

Action: Lunar calibration workshop organizers to provide one page summary on how the diffusion of lunar calibration expertise is intended to be done (as an example for best practise). To be also published in the GSICS Quarterly.

Action: Tim Hewison to provide a one-page summary of GEO/LEO IR products for QA4EO best practices showcase.

Action: CMA to investigate hosting a joint GSICS/CEOS-IVOS workshop to promote SI traceable measurements in orbit.

9g	User Interaction & 2014 Users Workshop		Larry Flynn
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The CREW community fully support the developments done by GSICS, in particular for IR and WV.

CREW recommends that GSICS provides as soon as possible equivalent products for VIS and NIR with a level of accuracy as high as possible (requirement is ~2%).

Recommendation: GRWG to liaise with CREW to get feedback on VIS/NIR GSICS products.

Action: Rob Roebeling and Dave Doelling to communicate on possibility of collaborations on inter-calibration / re-calibration in support to SCOPE-CM activities and report.

9h	Topics & Chairing next Web Meetings		All
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These were reviewed and updated online at

<https://gsics.nesdis.noaa.gov/wiki/bin/view/Development/MeetingsAndConferences>.

Action: KMA to investigate the feasibility of providing GSICS with its BRDF model and report.

9i	Format, Date & Place of Next WG Meetings		All
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There is an ongoing need for joint meetings between Research and Data working groups, in particular as more products are becoming pre-operational or operational. It was agreed that the Mini Conference concept was useful and should be continued in a similar way. However, for rest of the meeting, **presentations should stick to 10min in order to allow to 10min discussion.**

GPRCs are invited to focus exclusively on their achievements regarding GSICS activities for the sake of time.

IMD proposed to host the next GSICS annual meeting in New Delhi. This proposition was warmly welcomed and will be followed up by selecting a date..

It was discussed whether to co locate the 2015 GSICS Users Workshop with the next annual meeting, but this idea was rejected as the focus should be on the users, so we should continue to host these at conferences attended by users.

9j	Any Other Business		All
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None.

Meeting Attendees

CNES: Bertrand Fougnie, Denis Jouglet, Sophie Lacherade

CMA: Xiuqing ("Scott") Hu, Lin Chen, Ling Wang (Remotely), Na Xu (Remotely), Qifeng Lu (Remotely)

ESA: Berit Ahlers (as Observer and participant in UV Sub-Group)

EUMETSAT: Peter Miu, Tim Hewison, Sebastien Wagner, Rob Roebeling, Bartolomeo Viticchie, Xavier Calbet, Ruediger Lang, Ewa Kwiatkowska, Pepe Phillips, Thierry Marbach, Bertrand Theodore, Anne O'Carroll, Joerg Ackermann, Simon Elliot, Jo Schmetz, Rosemary Munro

IMD: Ashok Kumar Sharma

ISRO: Pradeep Thapliyal

JAXA: Keiji Imaoka (Remotely)

JMA: Keita Hosaka, Masaya Takahashi

KMA: Minjin Choi, Byung-II Lee

NASA: Dave Doelling, Xiaoxing ("Jack") Xiong, Matt Deland (Remotely)

NOAA: Manik Bali, Lawrence Flynn, Fangfang Yu, XingMing Liang, Laurie Rokke, Cheng-Zhi Zou (Remotely), Ralph Ferraro (Remotely)

USGS: Tom Stone

Invited Experts:

CAS/NSSC: Xiaolong Dong (Remotely)

DWD: Marc Schroeder

NPL: Nigel Fox

RMIB: Nicolas Clerbaux

SRON: Matthijs Krijger

Additional Observers:

EUMETSAT: Chris Hanson, Alessio Lattanzio, Michael Grzegorski, Rasmus Lindstrot, Pablo Benedicto, Marcel Dobber, Gary Fowler

Summary of Actions

Unless otherwise stated, all actions are due by the next annual meeting of the GSICS Research and Data Working Groups, which is expected to take place in March 2015.

1. **Action:** Bruce Wielicki (NASA) to investigate availability of lunar observation data from CLARREO demonstrator test flight and share these with CNES and USGS and notify CNES of future balloon flights so Pleiades observations can be synchronised.
2. **Action:** Nigel Fox to follow-up invitation for IVOS and WGCV contributors to submit articles to the GSICS Quarterly newsletter.
3. **Action:** GDWG to investigate how many people currently use GSICS products.
4. **Action:** Dave Doelling to provide EUMETSAT with DCC SBAFs for Met-8 and -10 by June 2014.
5. **Action:** Bertrand Fougne to provide smoothed DCC BRDFs derived from PARASOL observations.

6. **Action:** GDWG to investigate methods to structure the order the global attributes within the netCDF file - e.g. between attributes related to the method and the application.
7. **Action:** GDWG to investigate how to include algorithm type in filename.
8. **Action:** Sebastien Wagner to share strawman netCDF file for DCC products for review at web meeting.
9. **Action:** EUMETSAT and JMA to prepare a list of requirements to participate in a lunar calibration workshop, applying a common version of the ROLO model and report on timing and feasibility of hosting such an event in time for workshop at a web meeting in May/June 2014.
10. **Action:** Fangfang Yu to propose what the variables should be in the netCDF file to provide information on the calibration diurnal variation, and report to GRWG.
11. **Action:** CMA and JMA to present their analysis on GEO-GEO IR products at the next meeting.
12. **Action:** CMA to present plans for developing inter-calibration products for GEO hyperspectral IR sounder.
13. **Action:** EUMETSAT to provide support to CMA on navigation of the MSG satellites as requested.
14. **Action:** Tim Hewison to send CNES example GSICS Corrections with embedded delta corrections for further analysis.
15. **Action:** GCC need to identify a user for advice on preferred format for delta correction.
16. **Action:** EUMETSAT to implement the delta corrections in GSICS products using Metop-B/IASI.
17. **Action:** CNES and EUMETSAT to investigate differences in their IASI-A, -B and CrIS comparison methods and results, and report these by the next annual GRWG meeting.
18. **Action:** XingMing Liang to report the requirement from GSICS to support MICROS.
19. **Action:** GRWG Chair to investigate the possibility to form a sub-group to develop inter-calibration products based on double difference comparisons with model data (NWP/RAOB+RTM).
20. **Action:** CMA to provide ATBD for FY-3C IR product.
21. **Action:** EUMETSAT to report the AVHRR-IASI inter-calibration work in next meeting.

22. **Action:** GSICS Executive Panel Chair shall write to the GPRCs to confirm the committed availability of the proposed GSICS working group members required to complete the tasks assigned to him/her.
23. **Action:** IMD to search for a technical person to support the work of GDWG.
24. **Action:** GDWG shall have a THREDDS configuration web meeting in July.
25. **Action:** GDWG shall have a DOI/OID web meeting in May/June.

26. **Action:** Scott Hu (CMA) to double check that access to Webex and Google document is available from China to support GSICS activities.
27. **Action:** Scott Hu (CMA) to provide WMO and GDWG with the name of the CMA GDWG member.
28. **Action:** GCC to coordinate with WMO to add GSICS products catalogue to WMO OSCAR database.
29. **Action:** KMA to provide GCC with links to GEO-LEO-IR data and products for inclusion into the product catalogue.
30. **Action:** KMA to send products to the EUMETSAT GSICS Data and Products server until the CMA collaboration server is available.
31. **Action:** EUMETSAT shall provide a method to formalise this process in an automated way (if possible).
32. **Action:** All GPRCs to respond to CGMS-41: WGII/3 Action 41.22: "CGMS agencies to provide working papers on current and future capabilities for calibration monitoring and event logs – CGMS-42." (Already closed)
33. **Action:** All GPRCs to provide satellite instrument specific links to calibration events to WMO-OSCAR.
34. **Action:** All GPRC to seek consensus on common naming conventions for calibration events at the level of Main-Categories/Sub-Categories/Event Types.
35. **Action:** EUMETSAT/NOAA/NASA/JMA to define a calibration events database design, and if needed, discuss this in a future web meeting.
36. **Action:** EUMETSAT to keep in contact with WMO on adopting OSCAR to include links to instrument events web-pages.
37. **Action:** All GPRCs to review their GSICS websites to take into account of the new developments in GSICS as these websites will be reviewed in the next joint meeting.
38. **Action:** IMD to update their website to provide GSICS information. This will be provided on the WMO for inclusion into their website.
39. **Action:** Masaya Takahashi to check for a document regarding minimum content for GPRC GSICS webpage. If this document does not exist, then he shall author one and upload it to the Wiki.
40. **Action:** EUMETSAT to support the creation of a GitHub account for uploading the GSICS related codes for collaboration development.
41. **Action:** GCC to upload the netCDF checker to the GitHub account.
42. **Action:** GCC to update Taxonomy information to the Wiki or GCC website.
43. **Action:** GPRCs are invited to clearly nominate their member for the GPAT. The GPAT member should promptly coordinate the review of the GSICS products before operations. This information will be presented into the GCC website.
44. **Action:** EUMETSAT to prepare a proposal for automating the GPPA and demonstrate this in a web meeting.
45. **Action:** GCC to take a lead in discussing the GPPA with GSICS members to reduce the amount of time needed to move through the phases.
46. **Action:** GCC will discuss with GPRCs to prepare for the GSICS user conference 2014 to promote the GSICS products.
47. **Action:** GCC shall take a look at WMO/CGMS documents to prepare templates for GSICS documents and provide these to the GDWG for discussion.
48. **Action:** GCC shall provide a Document Management Plan (for example NOAAs) to the GDWG so that GSICS has a framework to publish documents.
49. **Action:** Xu Na (CMA): report at the next meeting on the work done on SRF retrieval using hyperspectral instruments.

50. **Action:** EUMETSAT to share with IMD plans for reprocessing of the archive data (re-calibration)
51. **Action:** EUMETSAT to provide feedback at web meeting on how to handle DCC seasonality by Oct 2014.
52. **Action:** EUMETSAT/NOAA/NASA/JMA to perform analysis to evaluate the optimal temporal resolution for a DCC product. GPRCs are invited to report at the next web-meeting on the DCC method.
53. **Action:** Dave Doelling to provide all GPRCs with a survey to prepare the path forward on calibration methods (other than DCC and lunar methods). Nigel Fox will liaise with CEOS-IVOS on this topic. The outcome of the survey will be discussed at a web meeting.
54. **Action:** GCC and Tim Hewison to follow up on the support to CEOS WGCV regarding the GPPA as an example for best practises for QA4EO - after reviewing at web meeting in Summer 2014.
55. **Action:** Lunar calibration workshop organizers to provide one page summary on how the diffusion of lunar calibration expertise is intended to be done (as an example for best practise). To be also published in the GSICS Quarterly.
56. **Action:** Tim Hewison to provide a one-page summary of GEO/LEO IR products for QA4EO best practices showcase.
57. **Action:** CMA to investigate hosting a joint GSICS/CEOS-IVOS workshop to promote SI traceable measurements in orbit.
58. **Action:** Rob Roebeling and Dave Doelling to communicate on possibility of collaborations on inter-calibration / re-calibration in support to SCOPE-CM activities and report.
59. **Action:** KMA to investigate the feasibility of providing GSICS with its BRDF model and report.

Summary of Decisions

Decision: The VIS/NIR Sub-Group plan to continue to develop untargeted DCC method as GSICS product, while continuing to research DCC ray-matching for future products, when contemporaneous observations are available.

Decision: It was agreed that delta corrections will be needed for each specific GSICS products, which can be derived from double-differences of applying MODIS and VIIRS as independent references in each algorithm.

Decision: Meanwhile, demo products will include one global attribute to describe all the configuration of the algorithm needed to provide traceability to ensure the product is reproducible by the creator.

Decision: DCC products will follow a similar style as current GEO-LEO IR ones - ie multiple NRTC files each containing results for single day, and a single RAC file containing results for the whole time series - preferably in daily time steps, or otherwise monthly.

Decision: It was agreed that the definition of merged community references is a good medium-term goal for GSICS - both in the reflected solar band and thermal infrared, as more potential reference instruments are become available.

Decision: The diurnal calibration variation should be provided in GEO-LEO IR products before promotion to operational status.

Decision: One aspect of the GPPA review process was clarified: in case of equivalent products for instruments of the same series, the product generator should still complete the GPPA form. The GCC should pass this to reviewers, highlighting any differences from previous implementations. Reviewers could give their consent for more than one product at once unless a specific review is required. In the case no response is received before the specified deadline, promotion can continue.

Decision: GSICS products shall have a persistent identifier using a standard like DOI or OID (Object Identifier). This will allows them to be uniquely identified and referenced.

Summary of Recommendations

Recommendation: Marc Schroeder (DWD) to share ATBD to define Common Reference Channels with GRWG for voluntary review.

Recommendation: Ewa Kwiatkowska agreed to formulate suggested wording for recommendation from GRWG to the Ocean Colour Community to provide a full uncertainty analysis (including correction of atmospheric contribution by RTM) for GRWG members to review.

Recommendation: CMA to follow-up bilaterally with NPL to discuss how to pursue potential implementation of a TRUTHS-like instrument on a Chinese satellite.

Recommendation: JMA to run RTM simulations over only Aqua/MODIS DCCs.

Recommendation: CNES to repeat BRDF analysis from PARASOL over land in Africa and report at web meeting.

Recommendation: KMA to validate their implementation of ROLO model against that of other GSICS members.

Recommendation: Jack Xiong will investigate the phase angle dependence in the MODIS lunar observations together with Tom Stone and report at a Web Meeting.

Recommendation: CNES to consider extending the error budget to apply the Rayleigh scattering method to bias trending.

Recommendation: EUMETSAT to try using SRF of Met-8/HRV for Met-7 lunar calibration & DCC.

Recommendation: JMA to investigate the possibility of correcting Aqua/AIRS to IASI-A as a delta correction.

Recommendation: Cheng-Zhi to provide Tim Hewison with information on potential radiosonde pressure errors to be followed-up at GSICS-GRUAN-GNSRO workshop in May 2014. (Done by email 2014-04-03, which referenced Stauffer *et al.*, 2014, who showed errors of ~0.5hPa for the RS92 and ~2hPa for other sensors. These are not sufficient to explain the biases reported above.)

Recommendation: Manik Bali to investigate a variational approach to the SRF retrieval problem and report example application to a non-window channel, including uncertainties, at the next annual GRWG meeting.

Recommendation: GDWG to research NOAA DOI meaning and revisit this discussion in a web meeting.

Recommendation: When a dedicated Calibration Change Alert is needed, NOAA shall coordinate a web meeting to demonstrate how ICVS can be used for the implementation of such a system.

Recommendation: Alternatively, EUMETSAT to investigate the use of the bias plotting tool to generate calibration alerts through the analysis of the GSICS products.

Recommendation: The GDWG members are strongly encouraged to work with their GRWG to explore how Big Data technology can be applied to GSICS activities, and discussed them in a future web meeting.

Recommendation: all GPRC to assess if history events can be made available and report this in the next GSICS joint meeting.

Recommendation: GDWG shall support the development of the CF convention and provide input to the CF governance committee. This can be done using Webex or in the joint meeting.

Recommendation: CMA and EUMETSAT (Xu Na and Ruediger Lang) to investigate and report on the stability of the GOME-2 dataset with respect to Aqua/MODIS

Recommendation: CNES to provide a BRDF model over land for Meteosat.

Recommendation: GRWG to liaise with CREW to get feedback on VIS/NIR GSICS products.

Recommendation: All GPRCs to review the calibration events database design, and to test the robustness of the proposed design through a pilot study, and report their findings to the GDWG.