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In This Issue

Launch of JPSS-1 (L) Sentinel-5P (M) and FY-3D (R)

JPSS-1, FY-3D and Sentinel-5P launched

By Manik Bali(NOAA), Lawrence Flynn (NOAA), Jun Yang(CMA), Peng Zhang(CMA), Lin Zhang(CMA), Dongfeng Luo (CMA), Changyong Cao(NOAA) and Quanhua Liu(NOAA)

The last quarter of 2017 saw the launch of three new earth observation satellites, these were, CMA's Feng Yun-3D on 15th November 2017, NOAA's NOAA-20 (JPSS-1) on 18th November 2017 and ESA/Eumetsat Sentinel-5P on 13th October 2017. Together, these polar satellites span the Earth-observing spectrum with NOAA-20 and FY-3 instruments operating in VIS, NIR, IR, MW and UV and Sentinel-5P observing the earth in the UV and VIS/NIR.

NOAA-20

The JPSS-1 satellite has been christened as NOAA-20. It has five instruments onboard. These are the **1)** Cross-track Infrared Sounder (CrIS), **2)** Advanced Microwave Sounding Instrument (ATMS), **3)** Visible Infrared Imaging Radiometer Suite (VIIRS), **4)** Ozone Mapping and Profiling Suite (OMPS) and **5)** Earth's Radiant Energy System (CERES) instrument. CERES measures reflected sunlight and thermal radiation emitted by the Earth. These instruments are expected to provide continuity for the measurements from instruments on the S-NPP satellite. By design, the calibration performance of NOAA-20 is expected match or better the S-NPP performance. In comparison to S-NPP ATMS, NOAA-20 ATMS significantly reduces the channel-to-channel noise correlation.

The NOAA-20 ATMS antenna efficiency has also been largely improved for channel 17 and all 5 water vapor channels. Additional hardware was installed for the NOAA-20 CrIS. It has three PRTs at the base of target blackbody and a cavity wedge design for the internal blackbody.

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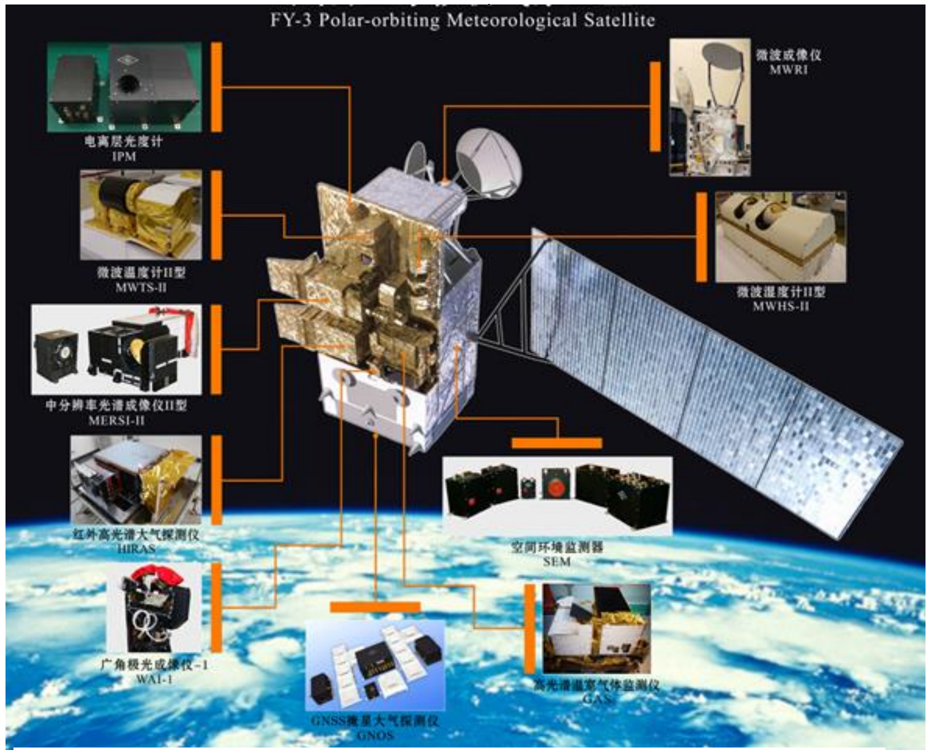

Figure 1: Instruments onboard the FY-3D Satellite.

The NOAA-20 VIIRS is an upgrade from the one onboard S-NPP. The upgrades include improved mirror coating and new filters. Several performance issues existed on Suomi NPP VIIRS are also resolved. The NOAA-20 OMPS uses Quartz Volume Diffusers for improved solar measurements and it uses lossless compression so it can send down higher spatial resolution measurements. Unfortunately, the suite does not have a Limb Profiler. This instrument is expected to return for NOAA-21.

It is expected that the measurements from the five instruments will improve day-to-day weather forecasting while extending the record of many long-term observations of Earth's climate. In the final orbits, the S-NPP and NOAA-20 will be 180 degrees out of phase, i.e., one half orbit or 50 minutes apart. The NOAA-20 instruments are expected to provide reference quality measurements that can complement / replace the roles of S-NPP instruments in GSICS.

FY-3D

The launch of FY-3D was is a major step in observing the Earth. FY-3D is carrying ten remote sensing instruments (Fig.1) with configuration and performance indices of the payloads up to the world's top levels. Besides five follow-on instruments, the Hyperspectral InfraRed Atmospheric Sounder (HIRAS), the Greenhouse Gases Absorption Spectrometer (GAS), the Wide-angle Aurora Imager (WAI), and the Ionospheric PhotoMeter (IPM) are brand new instruments put onboard for the first time. What is more, the function of the core instrument MERSI (Medium Resolution Spectral Imager) is significantly upgraded. The sounder HIRAS adopts the cutting-edge technique in the world, the number of spectral channels is 70 times more than the previous one. It is expected to provide stronger support for medium and long range numerical weather prediction in China, e.g., to significantly increase the forecast efficiency for typhoon landing or other high-impact weather events up to 5 to 7 days in advance.

MERSI is one of the core instruments on FY-3. The upgraded version of MERSI is comparable in performance to the VIIRS onboard the NOAA JPSS satellites. MERSI is capable of precise, quantitative detection for clouds, aerosols, and ocean colors, useful for disaster monitoring and ecologic environment management at home and abroad.

Sentinel-5P

The Sentinel-5P satellite launched under the Copernicus program of the European Space Agency has the TropoMI instrument onboard. It will continue the record of ozone and other trace gases measurements from SCIAMACHY, GOME-2 and OMI but at even better horizontal resolution. This is a precursor satellite mission; Sentinel-5P aims to fill in the data gap and provide data continuity between the retirements of the Envisat satellite and the NASA's Aura mission and the launch of Sentinel-5.

For information on the NOAA-20 satellite, see the press releases at http://www.jpss.noaa.gov/launch.html. Additional information on FY-3D is at http://www.nsmc.org.cn/en/NSMC/Contents/100252.html and on Sentinel-5P http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Sentinel-5P. All three satellites instruments can be found at https://www.wmo-sat.info/oscar/

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Creating a Multi-decadal Oceanic Microwave Brightness Dataset: Three-way Inter-satellite Radiometric Calibration between GMI, TMI and WindSat

by Ruiyao Chen and W. Linwood Jones (UCF)

The Tropical Rainfall Measuring Mission (TRMM) was launched in 1997, carrying a precipitation radar (PR) and a Microwave Imager (TMI) to produce rainfall statistics in the tropics. The scientific role of TRMM was later expanded to measure precipitation globally, by forming a constellation of weather satellites carrying microwave radiometers to measure rainfall, which became the current Global Precipitation Measurement (GPM) program. For this constellation, a common rain retrieval algorithm (GPROF) was used, which assumed that all the radiometers were intercalibrated. For this purpose, TMI was designated the radiometric transfer standard for inter-satellite radiometric cross-calibration (XCAL), until its decommissioning in 2015. The follow-on GPM mission was launched in 2014 to provide data continuity and to improve precipitation measurement capabilities at high latitudes. Since the radiometric transfer standard was subsequently changed to the GPM Microwave Imager (GMI), it is highly desirable to perform XCAL between GMI/TMI to form a multi-decadal climate dataset.

Since both TRMM and GPM operated simultaneously from March 2014 to April 2015, it was possible to perform XCAL during this period; however, this limited (13-month) overlap period raises concern about the XCAL stability over the 17-plus-year lifetime of TMI. Fortunately, the WindSat radiometer has operated since January 2003, and a number of radiometric evaluations have been published to provide high confidence in its brightness temperatures (Tb) [Jones et al., 2006] and the long-term relative stability between TMI/WindSat over oceans [Chen et al., 2014]. Thus, using WindSat as the calibration bridge, we will apply TMI/GMI calibration bias throughout the entire time-series for the legacy reprocessing of TRMM Tb product 1B11 V8 (GPM05), which should mitigate any long-term radiometric calibration stability issues, if they occur.

CFRSL's Double-Difference (DD) technique [Biswas et al., 2013] was used to perform XCAL for TMI/GMI/WindSat during their overlap period, and the time series of monthly-averaged DD radiometric biases for 10V and 10H channels are presented in Fig. 1. These results demonstrate that the DD biases are remarkably stable over the entire period (fluctuations typically < ±0.25K), and similar results are observed in the other channels (19, 23 & 37 GHz). Though there are significant mean biases between instruments, this is not an issue because these offsets will be applied to transform the various radiometer Tb's to be equivalent to GMI. Also, to assess the stability of the XCAL, the DD's were stratified by latitude, and results showed negligible dependency on geographical location.

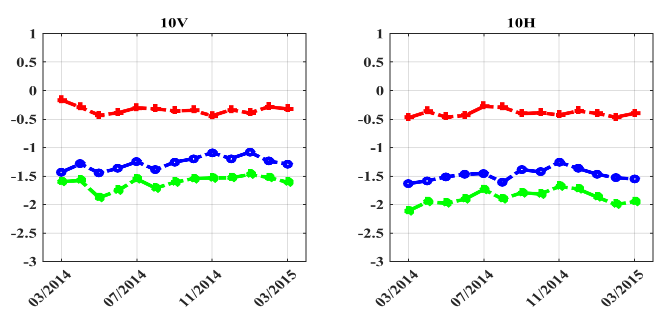

Figure 1. Monthly DD of 3-way inter-calibration, TMI to WindSat (red), WindSat to GMI (blue) and TMI to GMI (green), for 10V and 10 H channels.

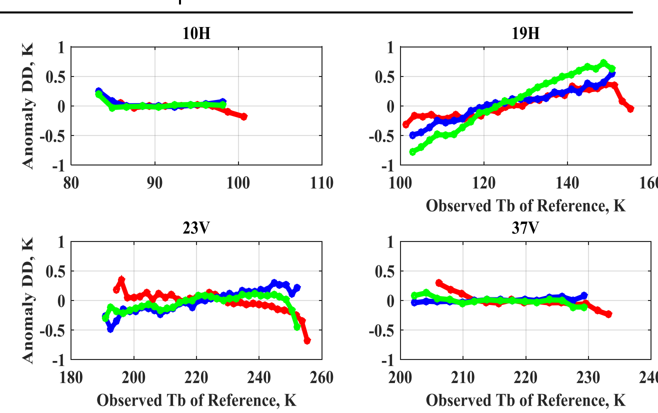

Figure 2. Radiometer channel bias anomalies (DD – mean-DD) stratified by the average scene Tb_{obs} for the reference radiometer, which is WindSat for TMI & WindSat, and GMI for the other two radiometer comparisons. Red line indicates DD's between TMI and WindSat; blue is WindSat and GMI; green is TMI and GMI.

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Table 1. Double differences, Mean & STD, where upper panel is ±1 Hr and lower panel is ±2 Hr

μ / σ	10v	10h	19v	19h	23v	37v	37h
TMI-WS	**-1.24/0.29**	**-1.42/0.35**	**-0.33/0.54**	**-2.34/0.75**	**-1.59/0.58**	**-4.19/0.49**	**-3.81/0.74**
WS-GMI	**-0.39/0.20**	**-0.39/0.25**	**1.35/0.38**	**2.13/0.60**	**1.82/0.44**	**2.30/0.35**	**2.90/0.58**
TMI-GMI	**-1.63/0.27**	**-1.81/0.34**	**1.02/0.54**	**-0.20/0.79**	**0.22/0.57**	**-1.89/0.47**	**-0.91/0.68**
μ / σ	**10v**	**10h**	**19v**	**19h**	**23v**	**37v**	**37h**
TMI-WS	**-1.23/0.31**	**-1.46/0.38**	**-0.25/0.57**	**-2.29/0.87**	**-1.46/0.70**	**-4.15/0.57**	**-3.74/0.96**
WS-GMI	**-0.36/0.22**	**-0.40/0.30**	**1.39/0.42**	**2.12/0.71**	**1.84/0.56**	**2.34/0.42**	**2.89/0.76**
TMI-GMI	**-1.58/0.30**	**-1.85/0.37**	**1.14/0.57**	**-0.17/0-90**	**0.38/0.70**	**-1.81/0.56**	**-0.85/0.93**

Further, to examine the radiometer calibration linearity, DD anomalies (means subtracted) are plotted against the reference radiometer Tb in Fig. 2; and for most channels, the results are flat indicating that there are no systematic dependencies on scene Tb. However, for 19H and 23V channels, there is a slight linear dependence, where the worst-case slope (< 0.03 K/K) occurs for 19H, but after considerable investigation, we do not believe that this is caused by radiometer non-linearity. For example, when using an ocean-surface emissivity model from Remote Sensing Systems [Meissner et al., 2012] and the same DD anomalies are stratified by GDAS surface wind speed, the results are nearly constant over the entire wind speed range for each channel. Moreover, for these channels, there is a significant atmospheric Tb component that is proportional to the integrated water vapor density. Thus, we suspect this scene-dependent effect is a residual error associated with imperfect radiative transfer modeling of the water vapor resonance near 22.22 GHz, which is used in the XCAL DD technique.
Finally, as predicted by the central limit theorem, this analysis shows that the DD histograms for all radiometer channels are Gaussian, and the corresponding mean DD biases (μ) and standard deviations (STD, σ) are tabulated in Table I for two temporal collocation windows (±1 hr and ±2 hr). The DD STD values from both panels indicate that the H-pol results have higher variation than V-pol for all the DD's sets; where the greatest stability occurs in 10V and the most variability in 19H and 37H.

In summary, DD biases and anomalies between TMI/WindSat, WindSat/GMI and TMI/GMI are characterized on a channel basis for the 13-month period, and the results are stable with small variance. The mean DD's are constants with almost no systematic effects; thus, overlap of WindSat with TMI and GMI will provide a well calibrated multi-decadal time-series of Tb's for global precipitation measurements.

References

Jones, W. L., Park, J. D., Soisuvarn, S., Hong, L., Gaiser, P. W. and Germain, K. M. St., 2006, Deep-space Calibration of the WindSat Radiometer, IEEE Trans. GeoSci. Rem. Sens., Vol. 44, No. 3, 476–495, 10.1109/TGRS.2005.862499

Chen, R., Santos-Garcia, A., Farrar, S., Jones and W. Linwood., 2014, Assessment of the Long-term Radiometric Calibration Stability of the TRMM Microwave Imager and the WindSat Satellite Radiometers, 13th Specialist Meeting on Microwave Radiometry and Remote Sensing of the Environment (MicroRad), Pasadena, California, 187–191, March 2014

Biswas, S. K., Farrar, S., Gopalan, K., Santos-Garcia, A., Jones, W. Linwood and Bilanow, S., Intercalibration of Microwave Radiometer Brightness Temperatures for the Global Precipitation Measurement Mission, 2013, IEEE Trans. GeoSci. Rem. Sens., Vol. 51, No. 3, 1465–1477, 10.1109/TGRS.2012.2217148

Meissner, T., Wentz, F. J., The Emissivity of the Ocean Surface between 6 and 90 GHz over a Large Range of Wind Speeds and Earth Incidence Angles, 2012, IEEE Trans. GeoSci. Rem. Sens., Vol. 50, No. 8, 3004 - 3026, 10.1109/TGRS.2011.2179662

Discuss the Article

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Degradation monitoring of the PROBA-V instrument

by Sindy Sterckx and Stefan Adriaensen (VITO)

Introduction

Due to the absence of on-board calibration devices the radiometric calibration and stability monitoring of the PROBA-V (Project for On-Board Autonomy – Vegetation) instrument relies solely on vicarious calibration approaches. The OSCAR (Optical Sensor CAlibration with simulated Radiance) Cal/Val facility, which was developed for the PROBA-V mission, contains a range of vicarious methods such as lunar calibration, calibration over stable desert sites, deep convective clouds (DCC), and Rayleigh scattering. By applying a set of different vicarious methods and inter-comparing their respective results systematic errors inherent to one or more techniques can be dealt with, random errors can be reduced by statistical averaging, results can be validated independently and the final radiometric accuracy can be improved. Besides the lack of on-board calibration devices the in-flight radiometric of the PROBA-V instrument is complicated by the complexity of the instrument design. To cover the wide angular field of view (i.e. 101°) in the small-sized PROBA platform, the optical design of PROBA-V is made up of three identical cameras. Each camera has two focal planes, one for the short wave infrared (SWIR) band and one for the visible and near-infrared (VNIR) bands. The SWIR detector is a linear array composed of three mechanically staggered detectors (see Sterckx et al., 2014). In this article we focus on the monitoring of the instrument response temporal evolution over its 4 years in orbit.

Temporal evolution monitoring

Calibration over the Libya-4 desert site is one of the methods used to monitor the stability of the various spectral bands and cameras of the PROBA-V instrument. The OSCAR Libya-4 calibration relies on comparing the cloud-free TOA reflectance as measured by PROBA-V with modelled TOA reflectance values calculated following Govaerts et al. (2013). For the purpose of the degradation assessment of the instrument response, results are generated on the basis of a constant absolute calibration parameter (i.e., no calibration updates considered) and normalized to the first observation at start of the operational phase. A seasonal bias correction, following a cosine function, is performed on the results to correct for seasonal oscillations in the calibration results as described in Sterckx et al. (2016). A linear regression is fitted through the data to quantify the degradation over time. Results are given in Figure 1 for the CENTER camera.

The radiometric stability of the CENTER camera is also assessed through lunar observations performed twice a month at a phase angle of about 7° before and after full moon. No lunar calibration acquisitions are performed for the LEFT and RIGHT camera. For each lunar calibration acquisition the radiances observed by PROBA-V are integrated over the lunar image and compared against the values predicted by the in-house implementation of the published USGS ROLO Model (Kieffer & Stone, 2005).

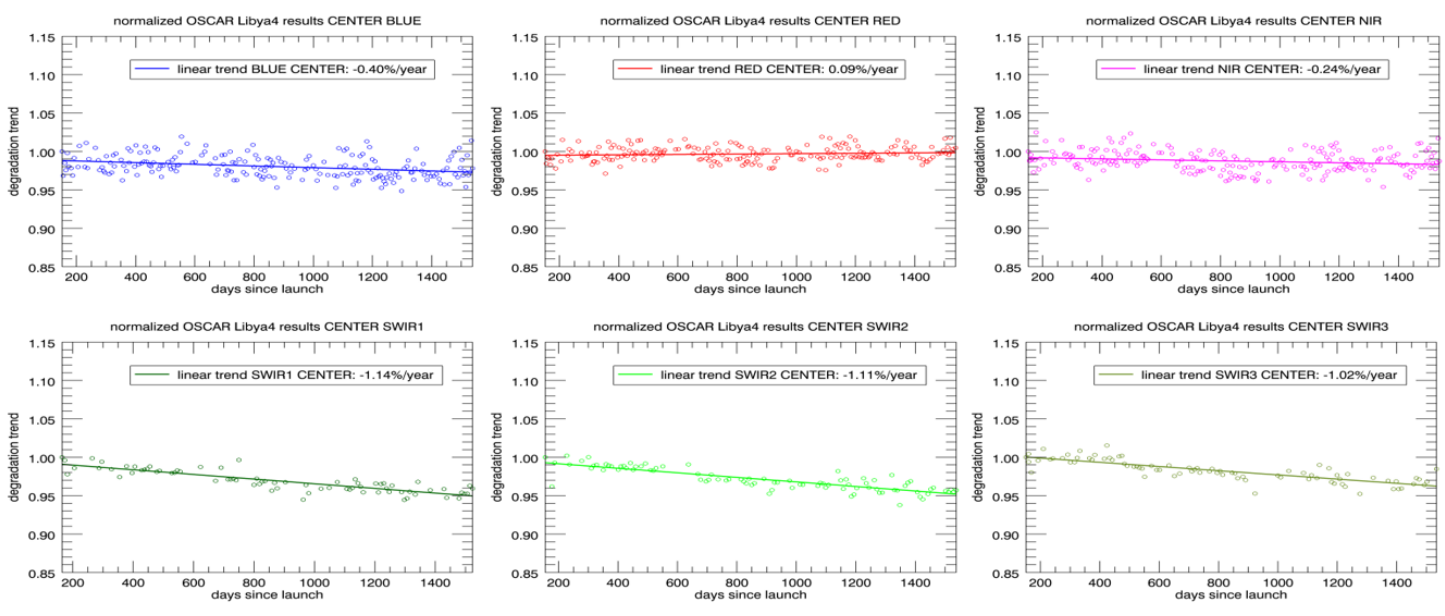

Figure 1. OSCAR Libya-4 results for CENTER camera: normalized and corrected for seasonal trend with linear model fitted to the results.

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This publication reveals the basic implementation steps and includes the lunar model regression coefficients. Lunar spectral sand smoothing is implemented, based on coefficients calculated by Tom Stone, specifically for the PROBA-V lunar acquisition phase angle.

Finally the temporal evolution of the instrument response in BLUE and NIR band relative to the RED band is also monitored using the DCC inter-band calibration method where the RED band is used as a reference band to retrieve the cloud optical depth (Sterckx et al. 2013).

The linear trend per year obtained by the various approaches is given in table 1 for the different strips and cameras. For the VNIR bands all methods indicate a minor degradation in the BLUE (between -0.13% and -0.52 %/year depending on the method and camera). No degradation is observed in the RED, instead the positive trend, which is small but statistically significant, indicates an increase in responsivity. For the NIR band, conclusions vary slightly depending on the method and camera. For all SWIR strips a more significant degradation is observed, between -0.92 and -1.46%/year. A linear degradation model has therefore been applied to the absolute radiometric calibration parameters used in the reprocessed PROBA-V Collection1 data archive.

Table 1. Linear trend per year (±1 standard deviation) as calculated on the basis of the PROBA-V OSCAR Libya-4, DCC and lunar calibration results.

Band	Camera	Linear trend (%/year) ±1 standard deviation		
		Libya-4	DCC	Moon
BLUE	LEFT	-0.43+/-0.09	-0.52+/-0.03	
BLUE	CENTER	-0.40+/-0.08	-0.46+/-0.03	-0.30+/-0.03
BLUE	RIGHT	-0.13+/-0.06	-0.31+/-0.03	
RED	LEFT	0.14+/-0.04		
RED	CENTER	0.09+/-0.06		0.24+/-0.04
RED	RIGHT	0.24+/-0.06		
NIR	LEFT	-0.15+/-0.05	-0.12+/-0.03	
NIR	CENTER	-0.24+/-0.08	-0.24+/-0.03	0.0l+/-0.04
NIR	RIGHT	0.09+/-0.07	-0.10+/-0.03	
SWIR 1	LEFT	-0.97+/-0.07		
SWIR 1	CENTER	-l.14+/-0.08		
SWIR 1	RIGHT	-0.92+/-0.12		
SWIR 2	LEFT	-l.21+/-0.09		
SWIR 2	CENTER	-l.11+/-0.07		
SWIR 2	RIGHT	-l.46+/-0.09		
SWIR 3	LEFT	-l.11+/-0.12		
SWIR 3	CENTER	-l.02+/-0.08		
SWIR 3	RIGHT	-0.93+/-0.12		

Conclusion and future activities

In this paper we show that through combining various vicarious Cal/Val methods instrument degradation monitoring can be accurately done even in the absence of on-board calibration devices. For monitoring of the SWIR strips currently only calibration over stable desert sites is considered for PROBA-V. In order to have also for the SWIR strips an independent validation of the radiometry, the use of RadCalNet data acquired over the Railroad Valley Playa (United States) is currently under investigation by the PROBA-V Cal/Val team.

References

Govaerts, Y.; Sterckx, S.; Adriaensen, S. Use of simulated reflectances over bright desert target as an absolute calibration reference. Remote Sens. Lett. **2013**, 4, 523–531.

Kieffer, H.; Stone, T.C. The spectral irradiance of the Moon. Astron. J. **2005**, 129, 2887–2901.

Sterckx, S. et al. The PROBA-V mission: Image processing and calibration. Int. J. Remote Sens. **2014**, 35, 2565–2588.

Sterckx, S.; Adriaensen, S.; Livens, L. Rayleigh, Deep convective clouds and cross sensor desert vicarious calibration validation for the PROBA-V mission. IEEE Trans. Geosci. Remote Sens. **2013**, 51, 1437–1452.

Sterckx, S.; Adriaensen; S., Dierckx; W. ; Bouvet, M. In-Orbit Radiometric Calibration and Stability Monitoring of the PROBA-V Instrument. Remote Sens. **2016**, 8, 546.

Discuss the Article

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Developing vicarious calibration for microwave sounding instruments using lunar radiation

by Hu Yang, NOAA

1. Introduction

Lunar radiation is highly stable in the microwave spectrum, attributed to the stable geophysical property of the moon's surface. Therefore, the Moon can be used as a permanent reference target to evaluate the calibration accuracy and assess the long-term calibration stability for microwave radiometers. Indeed, the lunar observations can be obtained from most microwave sounders such as AMSU and ATMS when the antenna scans cold space for calibration and the lunar radiation enter the antenna main lobe. This so-called lunar intrusion can happen several times a year, and lasts two to three days each time. Therefore, many lunar observation samples are obtained during the instrument lifetime for use to calibrate and evaluate the lifetime stability of the microwave sounding instruments.

2. SNPP ATMS Lunar Observation Data Sets

During the lunar intrusion events, lunar observations can be obtained when the Moon enters FOV of cold space view. The effective brightness temperature of the Moon's disk can be derived from calibration equation as below:

$$TB_{moon}^{eff} = \left[\frac{T_w - T_c}{C_w - C_c^{min}}\right] \Delta C_{moon} \qquad (1)$$

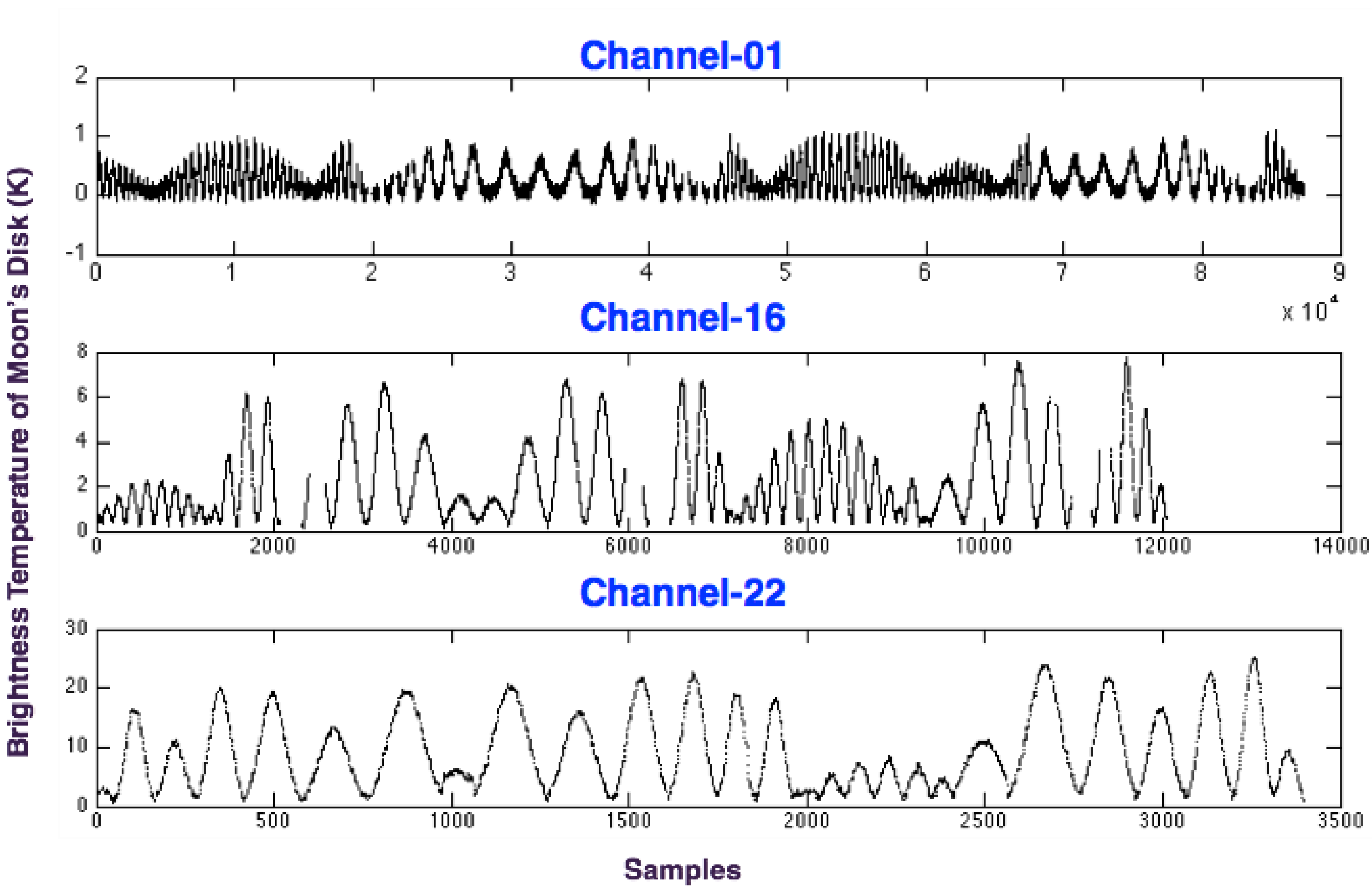

Figure.1 Typical case of the extracted and calibrated lunar brightness temperature at ATMS channel id 1, 16 and 22 (with 5.2°, 2.2° and 1.1° beam width).

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Where Tw and Tc are the warm load brightness temperature and cold space brightness temperature, C_w and C_c^{min} is warm load counts and the minimum cold counts free of lunar contamination within a scan, ΔC_{moon} is the difference between maximum and minimum space view counts at each scan. Note that to derive the reliable calibration results, Tw and Tc are further corrected for warm bias, earth side lobe contamination correction, as well as the reflector emission contamination correction.

Fig.1 shows a typical case of the extracted and calibrated lunar brightness temperature at ATMS channels 1, 16 and 22 (with 5.2°, 2.2° and 1.1° beam width). It shows that the maximum effective lunar brightness temperature is about 1K at K/Ka band, increasing to 8K at W band and can reach 20K at G band.

3. Lunar Microwave Brightness Temperature Simulation Model

For most of current polar-orbit space-borne microwave radiometer operating at around 800 km altitude earth orbit, the apparent angle of moon's disk is about 0.5°, which is much smaller than beam width of ATMS observations. When the Moon appears in satellite observation field of view (FOV), the effective microwave brightness temperature of moon's disk, TB_{moon}^{eff}, can be expressed as function of antenna response function G_{ant}, normalized solid angle of the moon Ω_{moon}, and average brightness temperature of the moon's disk :

$$TB_{moon}^{eff} = \Omega_{moon} \cdot G_{ant} \cdot TB_{moon}^{disk} \qquad (2)$$

Note that while Ω_{moon} and G_{ant} can be calculated from ground measured antenna pattern data, the pointing error needs to be corrected in geolocation processing. In this study, the beam pointing error was determined in terms of Euler angles from an algorithm combining coastline inflection points and the drift curve of lunar observations. A correction matrix then can be constructed and applied in geolocation process to correct the beam pointing error in lunar observations.

The Diviner Lunar Radiometer Experiment instrument (DLRE) onboard the Lunar Reconnaissance Orbiter was used to derive the mean surface temperature of the Moon's disk by averaging over the temperature at each phase angle, as plotted in Fig.2. It can be parameterized as function of Moon phase angle Θ by using a regression model as below:

$$T_{moon} = 100.89 + 85.65\,(1 - \cos\Theta) - 0.24(1 + \cos 2\Theta) \qquad (3)$$

For microwave radiometers like ATMS, a regolith of uniform physical temperature can be taken as a reasonable assumption, therefore the brightness temperature can be related to the surface emissivity of Moon's disk E_{moon}^{disk} and physical temperature Tmoon by using the equation below:

$$TB_{moon}^{disk} = E_{moon}^{disk} * T_{moon} \qquad (4)$$

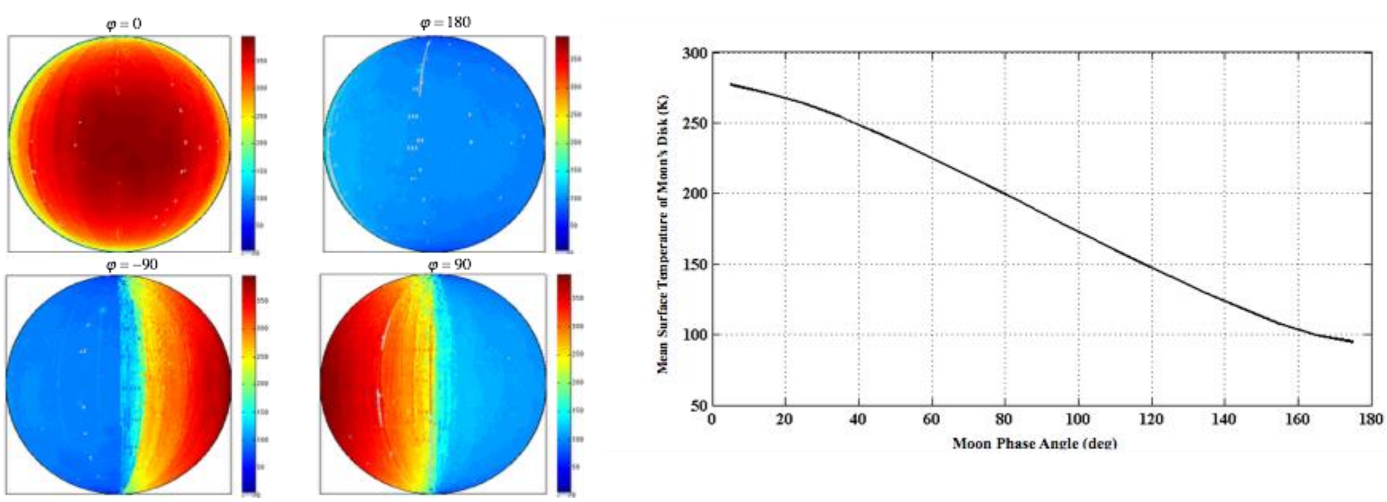

Figure.2 Global temperature distribution of lunar surface at different phase angle derived from 5 years average of DLRE observations (left) and the mean surface temperature of the Moon's disk (right).

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A total of 16594 lunar observation samples from 14 lunar intrusion events were collected in 2013. Substituting Eq. 4 to Eq. 2 yields the lunar surface emissivity E_{moon}^{disk} for 22 channels of ATMS with frequency 23.8 GHz to 183 GHz. The retrieved average emissivity of the Moon's disk has a minimum of 0.90 at K/Ka band (23/31 GHz), and maximum of 0.97 at W band (89GHz). Validation results shows that the mean bias of lunar model is less than 0.1K with a standard deviation around 0.2K in K, Ka, W and V bands, the standard deviation of model bias in G-band is conspicuously different from the other channels and close to 1K. This might be explained by the much higher noise of antenna pattern measurements in these high frequency channels and therefore the larger error in lunar model as a result.

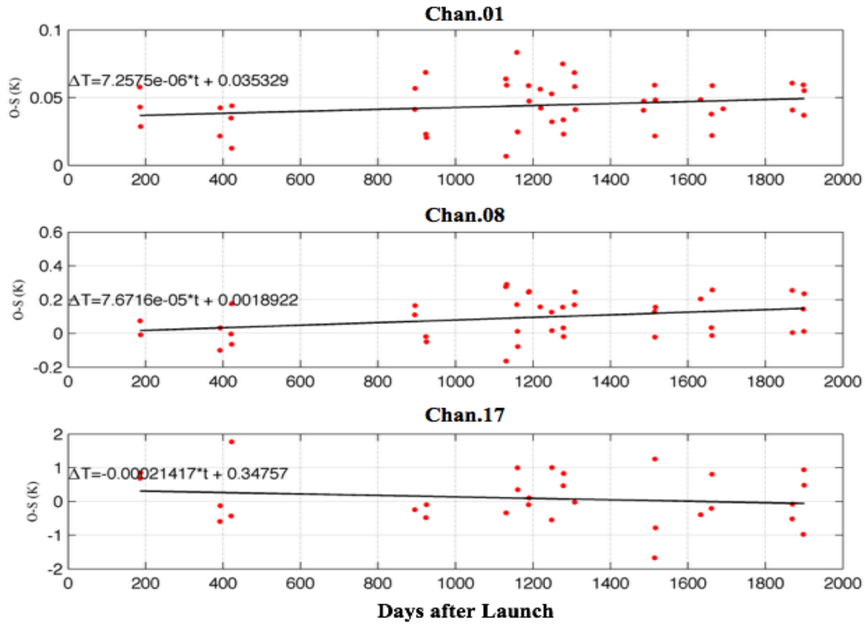

Figure.3 The calibration stability evaluation results for ATMS observations from December 3, 2011 to January 13, 2017. Panels from top to bottom are variation of daily average ΔT_{moon} for channel 1, 8, and 17.

4. Long-term Calibration Stability of Suomi NPP ATMS

The use of the moon as a Permanent Reference Target can also help to evaluate the long-term calibration stability of microwave sensors. Here, the lunar brightness temperature model developed in this paper is used to simulate the effective brightness temperature of moon's disk, and then compared with the measurements from ATMS instrument. Figure 3 shows the calibration stability evaluation results for ATMS observations from Dec. 3, 2011 to Jan. 13, 2017. Panels from top to bottom are variation of daily average ΔT_{moon} for channel 1, 8, and 17. The linear fitting line of ΔT_{moon} trend from six years of data is also presented. It is shown that for ATMS, the observed lunar Tb is highly consistent with the reference lunar Tb, with a mean bias of less than 0.5K in general and 0.05K for K/Ka and V/W bands in specific. SNPP ATMS shows a highly stable calibration status after 6 years on-orbit operation, the drift magnitude is less than 10^{-5}K /day for most of channels.

5. Summary and Conclusions

In this paper, a parameterized physical model was established to simulate the lunar microwave brightness temperature used in monitoring of the long-term calibration stability for the Suomi NPP ATMS instrument. The model established in this paper is based on the assumption that the top layer regolith of lunar surface is homogeneous and its effective temperature is equal to its surface temperature, therefore the effective emissivity can be retrieved. Since the antenna pattern can have significant impact on lunar observations, model parameters need to be recalibrate when applying the model to other instrument. In the future, when more lunar samples at different lunar phase are available, we can refine the model to make it independent of the DLRE surface temperature

References

[1]. H.Yang and F.Weng, "On-Orbit ATMS Lunar Contamination Corrections", IEEE Transactions on Geoscience and Remote Sensing, Vol. 54 Issue: 4 pp: 1-7, 2016.

[2]. H.Yang and F.Weng, "Estimation of ATMS Antenna Emission from Cold Space Observations", IEEE Transactions on Geoscience and Remote Sensing, VOL. 54, NO. 8, 2016.

[3]. S. Kigawa and T. Mo, "An Algorithm for Correction of Lunar Contamination in AMSU-A Data", NOAA Technical Report, NESDIS 111, 2002.

[4]. Jun Zhou, Hu Yang, Fuzhong Weng,, "Validate and improve atms geolocation accuracy by using lunar observations", IEEE International Geoscience and Remote Sensing Symposium, 2017.

[5]. J.-P.Williams, D.A.Paige, B.T.Greenhagen, E.Sefton-Nash, "The global surface temperatures of the Moon as measured by the Diviner Lunar Radiometer Experiment", ICARUS, 283, pp.300-325, 2016.

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News in this Quarter

GSICS Session organized in Asia Oceania Meteorological Users Conference (AOMSUC)

by Lawrence Flynn(NOAA), Manik Bali(NOAA), Mitch Goldberg (NOAA) and Zoya Andreeva (ROSHYDROMET)

The 2017 Global Space-based Inter-Calibration System (GSICS) Users' Workshop was held as a session at the AOMSUC-8 in Vladivostok Russia on 20 October 2017.
One of the main goals of the GSICS Session this year was to encourage participation of AOMSUC members in GSICS activities. The GSICS session was split into poster contributions as part of the main AOMSUC-8 poster session held on 19 October 2017 and an oral session held on 20 October 2017. The program included six poster and five oral presentations on GSICS related activities. Members from the Japan Meteorological Agency (JMA), the Japan Aerospace Exploration Agency (JAXA), the Korean Meteorological Administration (KMA), the China Meteorological Administration (CMA), the Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET), the State Space Corporation "ROSCOSMOS", the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautic and Space Administration (NASA) presented their work.

Mitch Goldberg, from NOAA, opened the GSICS oral session, which was jointly chaired by Mitch and Alexey Rublev, from ROSHYDROMET. Mitch introduced the audience to the critical building blocks (Collocation, Data Collection, Coordinated Operational Analysis and Assessments) that provide the foundation for GSICS role as a mainstay of inter-calibration for the consortium of agencies that have come together to monitor their GEO and LEO instruments. After describing the GSICS Organization he moved on to a description of GSICS deliverables. The list of deliverables included Algorithms, ATBD's, GSICS Tools (e.g., GIRO, SBAF), and User guides. He then gave example of instrument monitoring and provided a case study (flood mapping) that used the GSICS Correction for AHI to identify flooded areas. He described target users and the evolution of GSICS practices in instrument pre-launch characterization, in-orbit commissioning and improving calibration. He encouraged AOMSUC participants to expand their GSICS activities.

Following Mitch's talk, Manik Bali, from UMD ESSIC, gave an overview of the GSICS organization, products and resources. He noted that participation in GSICS activities has increased substantially over the years and members are increasingly utilizing GSICS algorithms in pre- and post-launch fine tuning of their instrument calibration. He encouraged members to subscribe to the GSICS newsletter and apply the GSICS (GEO-LEO and LEO-LEO) inter-calibration products which are freely available via product catalog. He then gave an overview of GRWG activities including recent discussion within GSICS on in-orbit references for Microwave instruments.
http://gsics.atmos.umd.edu/bin/view/Development/20170725

Larry Flynn, GCC Director, provided an overview of methods developed within the GSICS community to help in monitoring instrument performance and calibration. He gave examples of matchup comparisons (chasing orbits, simultaneous nadir overpass, nadir

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underpass, ray tracing and GEO Ring) with consideration of spatial and spectral resolution issues. He also gave short overviews of Deep Convective Clouds (DCCs) as invariant targets and the use Lunar models. The examples showed that GSICS is a mature system for generating inter-calibration products.
Ryo Yoshida from JMA gave a detailed overview of the Himawari 8/9 calibration performance. Himawari 8/9 have been the most modern GEO instruments that operate in the Asian region and view Japan, Korea, China and Southeast Asian region. Mr. Yoshida mentioned that GSICS-style inter-comparison with IASI-A helped in determining and correcting post-launch diurnal biases. He stated that AHI-8 calibration performance was improved by validating the RTM. The AHI-9 calibration performance was validated during its IOT phase and now matches with AHI-8. Further work is progressing on AHI-8 VNIR 5-6 positive bias for Band5 and Band6.

The session concluded with a talk by Alexey Rublev. Alexey gave a detailed overview of Cal/Val System for Russian Hydrometeorological Satellites. The Russian space program has satellites in GEO, LEO as well as Molniya orbits. Numerous geophysical products are created from the Russian Constellation. The satellites use a network of Roshydromet observation sites and comparison with Meteosat AVHRR and Terra MODIS instruments for calibration and validation.
Alexey described the use of the Cal/Val system established in Russia. This includes inter-calibration of Russian IKFS-2 atmospheric sounder from the payload of Meteor-M N2 and validation of its retrievals. The IKFS-2 is an IR Fourier-transform spectrometer The results of the IKFS-2 calibration versus Meteosat-10 / SEVIRI & IASI data show the high stability of IKFS-2 radiometric characteristics.
Comparisons were performed by matching the zenith angle view of the two instruments near the Gulf of Guinea. The spectrum measured by IKFS 2 was convolved with Spectral Response Function of the SEVIRI channels. It is important to note that the results obtained for 2015 between SEVIRI & IKFS-2 are very close to the comparisons results between SEVIRI & IASI. The results of new comparison performed in 2017 confirmed the high stability of IKFS-2 radiometric characteristics. Statistical comparison of IKFS-2 retrievals of temperature vertical profile versus radiosonde data was performed for Far-Eastern region in March –May 2017. The mean difference was less than 1 K.

The AOMSUC-8 poster session was held one day earlier and GSICS session posters were displayed in this session. Some of the notable ones include a poster by A. Filey et al. (SRC Planeta/ROSHYDROMET) on radiometric cross calibration of ahortwave channels of multi channel scanning unit onboard Meteor-M No 2 by using AVHRR measurements. Using AVHRR as a reference, inter-comparisons showed good correspondence with the reflectance coefficients registered in the first three AVHRR and MSU-MR channels: they deviate from 1.0 by not more than 4%, while their standard deviation does not exceed 1.3%. Another interesting poster was presented by A. Alexanin (IACP FEB RAS) on geometrical correction of images received by Resur-P satellites. A poster by Minju Gu (KMA) investigated the diurnal variation of the COMS bias by inter-comparison with hyper spectral instruments that cross the equator at various times of the day (CrIS & IASI).
L. Mitnik et al. (POI FEB RAS), presented their work on MTVZA-GY Microwave Radiometer onboard Meteor-M No. 2 Meteorological Satellite: External Calibration, Data Processing and Analysis of Marine Weather Systems. The work demonstrated a need for an in-orbit reference for microwave instruments. The complete AOMSUC program with links to abstracts and talks is available at http://aomsuc8.ntsomz.ru/wp-content/uploads/2017/10/AOMSUC-8_Agenda_conference_v6.pdf

Offline Discussions/Actions

Discussions with WMO to adapt the Action Tracker for WMO needs. Discussions with WMO for adapting Action Tracker for populating the OSCAR.In-Orbit references for entire spectrum of Microwave instruments.

- **Action**: Organize the 2018 GSICS Users' Workshop as a session at the EUMETSAT conference in Estonia in September 2018.
- **Action:** Provide contacts for IMD in their development of products from NOAA algorithms applied to their geostationary satellite instrument measurements.
- **Action**: Create and provide BMKG with a computer program to correct ground geolocation for elevated clouds based on satellite locations and view angles.
- **Action:** Remind NOAA personnel to check the WMO Observing System Capability Analysis and Review Database for Space-based Capabilities (OSCAR) entries for NOAA instruments.

Discuss the Article

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Outcomes of the Second Joint GSICS-IVOS Lunar Calibration Workshop

by Sébastien Wagner (EUMETSAT), Xiuqing (Scott) Hu (CMA), Shuang Wang (XIOPM), Thomas Stone (USGS), Xiangqian (Fred) Wu (NOAA) and Xiaoxiong (Jack) Xiong (NASA).

Lunar calibration has become a key component of the calibration tools implemented by satellite operators to monitor the drift of their instruments. The GSICS Implementation of the ROLO model (GIRO), developed by EUMETSAT, has been endorsed as the established community-available reference for lunar calibration, validated against the USGS ROLO model. It was a core goal following the First Joint GSICS/IVOS Lunar Calibration Workshop, which was organized in December 2014 by EUMETSAT in collaboration with USGS, CNES and NASA.

More recently, many initiatives were undertaken by the members of the Lunar Calibration Community to contribute to the international effort to achieve higher accuracy, to develop new approaches for lunar calibration reference models and to define new lunar inter-calibration products.

In order to pursue the efforts of sharing knowledge and expertise on lunar calibration, the Second Joint GSICS/IVOS Lunar Calibration Workshop was held in Xi'an, China, 13-16 November 2017, organized by the China Meteorological Administration (CMA) and the Xi'an Institute of Optics and Precision Mechanics organized in partnership with EUMETSAT, USGS, NOAA and NASA. More than 60 people representing 22 agencies or research institutes attended this workshop.

The main objectives of the workshop were i) to share knowledge and expertise on the latest dedicated ground-based lunar observation campaigns, and also space-based lunar datasets, that can help with refining the current lunar calibration reference, ii) to share knowledge and expertise in the preparation of lunar irradiance measurements from observations by the instruments to be monitored, iii) to work jointly on algorithms to compare and inter-calibrate instruments with lunar observation capabilities and iv) to explore further alternative applications of lunar observations for calibration purposes or post-launch assessments, such as geometric and MTF characterization.

Figure 1: 22 agencies and institutes were represented (including remote participations) at the Lunar Calibration Workshop organised in Xi'an (13-16 November 2017).

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Measurements and Moon Observations

CMA is leading an important activity in collaboration with other institutes from the Chinese Academy of Science on the development of new instruments and dedicated ground-based lunar measurement campaigns. The objectives are to develop new lunar calibration models both in irradiance and in radiance with a significantly reduced level of uncertainties and to achieve traceability to SI standards. Several campaigns took place in 2015, in 2016 and more recently in 2017. The current outcome of those campaigns were presented together with the foreseen future activities. New measurement campaigns are planned, with greater capabilities (automated acquisitions, broader spectral coverage and long time series for instance). Measurements from space are also part of CMA's future developments.
Other organisations are also investing resources in model development, processing of new lunar datasets from instruments in space and in acquiring new measurements from ground.

Finally, the discussions on Moon Measurements addressed the possibility to constitute a database for all the measurements currently available (satellites and ground-based). This database would support the development of new irradiance and radiance lunar models. There is a clear interest of the Lunar Calibration Community to see the GSICS Lunar Observation Dataset (GLOD) as an evolving dataset in order to i) allow more systematic cross-comparisons and inter-calibration and ii) support model development.

Using the ROLO and the GIRO and Lunar Model Developments

Following the effort initiated at the First Lunar Calibration Workshop, the participants presented the current status of their lunar image processing to prepare their irradiance input to the GIRO. Discussions addressed the estimation of the oversampling factor, which was already a concern at the first workshop. Some recommendations on how to estimate this factor were made in order to reduce the uncertainties on the results. In particular, it is recommended to use the sampling and scan rates to determine oversampling, and not spatial analysis of images. New datasets were also presented, in particular hyperspectral observations from GOME-2 aboard Metop-A and -B, and SCIAMACHY.
Regarding the evolutions of the ROLO, a three-year NASA-funded project will start in early 2018 at USGS to work on the original ROLO telescope data. This project will refine the irradiance measurements from ROLO images, reformat and recalibrate the images, and provide public access to the data to the Lunar Calibration Community and to the research community in general. This work is expected to reduce the uncertainties on the modelled irradiance.
As part of improving the traceability of the GIRO to the ROLO, the details of a benchmark dataset developed at EUMETSAT, in collaboration with JMA and USGS was presented. This benchmark is to be used to demonstrate the traceability of the GIRO to the ROLO model. The outcome of a first comparison are expected for the next GSICS annual meeting, in March 2018 in Shanghai.
Finally the session addressed the development of new models. As part of those developments, NOAA, CMA and JMA are investing efforts into the development of radiance models. The Lunar Calibration Community is also interested by working further on the development of a model accounting for the moon light polarization.

Inter-calibration and inter-band calibration

Currently, the inter-calibration using the Moon faces two major issues: first is the residual phase dependence in the GIRO (as in the ROLO) which causes the transfer of the calibration from a reference instrument to a target instrument difficult if those instruments are not observing the Moon in the same phase. The second issue is to move from MODIS Aqua, which is the current GSICS instrument reference for reflective solar bands, to Suomi NPP VIIRS as a new inter-calibration reference, in particular because have more bands in the reflective part of the solar spectrum. However, some of the bands available on MODIS Aqua and that are needed to monitor the reflective solar bands available on the new generations of geostationary satellites cannot be used. The SWIR bands for instance have cross-talk issues that need to be corrected, making their usage with lunar inter-calibration problematic. Additionally, in the context of GSICS activities, the lunar inter-calibration is foreseen to complement the inter-calibration using deep convective clouds (DCC) [1]. The fact that MODIS Aqua saturates over DCC in some bands required for the inter-calibration prevent their use in that context. The Lunar Calibration Community will continue investigating how to move forward on the topic.
As part of this session, some preliminary work was also presented and discussed on inter-band calibration using the spectral behavior of the Moon irradiance. It was agreed that more work is needed on this topic.

Alternative uses of lunar measurements

A large part of this session was dedicated to the post-launch estimation of the Modulation Transfer Functions (MTF), using Moon imagery. NOAA is leading an activity on algorithm

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comparisons. They tested their method on the datasets provided by the participating agencies (NOAA, JMA, KMA, CMA and EUMETSAT). The participating agencies presented their results using their own algorithms. Several issues were raised from the discussion on the technical aspects of processing Moon imagery to infer MTF curves: interpolation methods, selection of the region of interest for transition Moon/deep space, frequency to represent the MTF, accuracy of the oversampling factor estimation, etc. Those issues are also discussed by the CEOS WGCV IVOS group, and NOAA was invited to liaise with CEOS to benefit from IVOS experience. NOAA will coordinate the next steps of this activity, which is expected to lead to a GSICS/IVOS recommended approach.
The remaining part of the session addressed the use of lunar imagery to characterise artefacts such as optical and electronic cross-talk. CMA also presented their plan to calibrate MWHS, a microwave instrument aboard FY-3 series, using the moon.

Conclusion and Outlook

Looking at the future, the Lunar Calibration Community will continue its current efforts in improving the current ROLO and GIRO irradiance model references and developing and implementing inter-calibration schemas. New measurement campaigns are planned and are expected to lead to significant improvements in bringing lunar calibration to an absolute SI traceable scale. Those measurements will support the on-going effort to develop new radiance models for instance or to improve further the irradiance models.

The Second Lunar Calibration Workshop successfully brought together again the GSICS and CEOS/IVOS communities. New topics of interest such as MTF inference using Moon imagery could strengthen the exchanges between the two groups. Many CAS institutes working on the development of new instruments (including instrumentation dedicated to lunar observations) participated for the first time to the workshop. The increasing level of participation and discussion show the broad interest to use lunar calibration for instrument performance monitoring, cross-comparisons, inter-calibration but also for absolute calibration when available. A list of decisions, actions and recommendations [2] was established to pursue this international collaboration. After the success of the first and second Lunar Calibration Workshop, all participants agreed on the need to organize another Lunar Calibration Workshop within the next two years.

References

[1] Doelling D., Morstad D., Bhatt R., Scarino B., *Algorithm Theoretical Basis Document (ATBD) for Deep Convective Cloud (DCC) technique of calibrating GEO sensors with Aqua-MODIS for GSICS,* http://gsics.atmos.umd.edu/pub/Development/AtbdCentral/GSICS_ATBD_DCC_NASA_2011_09.pdf

[2] Second Joint GSICS/CEOS WGCV IVOS Lunar Calibration Workshop,http://gsics.atmos.umd.edu/bin/view/Development/20171106

[3] GSICS Lunar Calibration wiki page, https://gsics.nesdis.noaa.gov/wiki/Development/LunarWorkArea

Discuss the Article

Annual EUMETSAT Satellite Conference held in Cinecittà Studios Rome, Italy

by Manik Bali (NOAA) and Tim Hewison (EUMETSAT)

The 2017 EUMETSAT Meteorological Satellite Conference (#EMSC2017) took place on 2nd – 6th October 2017 in the Roman film studios "Cinecittà", Italy. The meeting was co-hosted by ITAF-ReMET (Italian Air Force - Operational Force Command, Department for Meteorology) and the national provider for weather and climate services in Italy. International experts in the field of meteorology, climatology and monitoring of the environment took part in the Conference. The conference had eight sessions in all:

Session 1 - Current and future satellite programs and instruments
Session 2 - New horizons for the Indian Ocean
Session 3 - Use of data from current and future satellites in very high-resolution NWP models
Session 4 - Atmospheric composition: recent advances in satellite products and applications
Session 5 - Marine environment monitoring: recent advances in satellite products
Session 6 - Satellite data in support of operational hydrology and water resources management
Session 7 - Use of satellite data in climate monitoring
Session 8 – Next generation geostationary satellites

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The session 7 on Use of Satellite Data in Climate Monitoring was particularly exciting for GSICS members. This session had talks by Tim Hewison, Wes Berg, Dave Doelling, Bin Zhang and Stefan Wunderle. Their talks gave examples of the use of GSICS algorithms in monitoring in-orbit instruments, building reference records for microwave instruments, re-calibration and building climate data records for microwave and visible instruments. Tim Hewison discussed uncertainty and traceability of reference instruments that are useful for monitoring in-orbit instruments.

Session 1 on Current and Future Satellite Programmes and Instruments was another interesting session for GSCIS researchers. In it, Martin Burgdorf spoke about using the Moon as in-orbit reference for monitoring microwave instruments and Christophe Accadia covered the Cal/Val activities for the EUMETSAT Polar System for Visible/Infrared Imagers (METImage). Manik Bali introduced the inter-calibration references for Microwave Instrument wherein AMSU/MSU FCDR was compared with ATMS to show its usefulness as an in-orbit reference. Christopher Merchant introduced new uncertainty concepts for current and future missions.

Several posters were extremely interesting for the GSICS community. A poster by Kun-II Jang of KMA on diurnal and seasonal variation of COMS Infrared Channels revealed significant signatures in the COMS imagery. A poster by Changyong Cao of NOAA on a Metop/AVHRR VIIRS inter-calibration algorithm revealed the bias chain from pre- to post-launch for AVHRR. A poster by Spencer Ferrar of Aerospace Corp. covered Inter-calibration of Cubesat Microwave Sensors. Dave Tobin of University of Wisconsin introduced the Cal/Val plan for NOAA-20 CrIS in his poster while Allesandro Piro's (of Serco Spain) poster identified discontinuities in MiPAS Band-A and Band-B. Kurihara's (of JMA) poster on physical retrieval of SST that uses GSICS style inter-comparison between Himawari-8 and Terra/MODIS gave an interesting approach for consideration by the GSICS community. Jack Xiong's (of NASA) poster covered the VIIRS Pre-launch calibration. Dave Smith's (of STFC) poster provided updates on the quality of the SLSTR instrument onboard Sentinel-3B.

Presentations, posters and proceedings will be published on the conference website:https://www.eumetsat.int/website/home/News/ConferencesandEvents/DAT_3212307.html.

OSCAR Workshop

WMO hosted a side event where key discussions on developing their Observing Systems Capability Analysis and Review (OSCAR) Tool. This provided a showcase for current capabilities of the OSCAR website, as well as scoping the potential evolution of future functionality. It was concluded that while OSCAR now provides an essential service to the Earth Observation community, it is vital to ensure the information it contains is up-to-date. Ideas were discussed to achieve this by nominating responsible points of contact in each agency operating the satellites.

The next EUMETSAT Meteorological Satellite Conference will take place in Tallinn, Estonia, from 17 to 21 September 2018.

Discuss the Article

Announcements

GSICS Annual Meeting 2018 to be held March 19-23, 2018 in Shanghai, China

by Xiuqing (Scott) Hu, CMA

The 2018 GSICS Joint Meeting on Research and Data Working Groups will be hosted by CMA and local host Shanghai Institute of Technology and Physics (SITP), Chinese Academy of Science (CAS). The Venue is **Baolong Hotel, Shanghai China**, from 19 (Monday) - 23 (Friday) March 2018.

The meeting will begin with a Mini-Conference, which is a session to discuss items to introduce GSICS products and items that are not yet directly linked to GSICS Products. This will be followed by a Plenary. The plenary is a member session and will cover topics related to the UV-VISNIR-IR-MW subgroups of GRWG and to activities of the GDWG and GCC. Reports from GSICS Processing and Research Centers (GPRCs) and discussion on cross-cutting issues will also be included. Following this, the GSICS Data Working

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Group (GDWG) and the GSICS Research Working Group (GRWG) will break out into parallel sessions while converging on important topics. The meeting will finish with a wrap up session where participants will discuss a summary of the meeting and the status of action items. Details of the meeting will be announced through the GSICS Wiki http://gsics.atmos.umd.edu/bin/view/Development/20180319.

2018 EUMETSAT Satellite conference to be held 17-21st September 2018 in Tallinn, Estonia

by Tim Hewison, EUMETSAT

The 2018 EUMETSAT Meteorological Satellite Conference will take place from 17 to 21 September 2018 in Tallinn, Estonia. Abstracts are invited through 31 Jan 2018 covering topics in the areas listed below:

1) Current and future meteorological satellite systems and data access,
2) Preparing for MTG and EPS-SG,
3) Nowcasting and high-resolution numerical weather prediction: observational input and the integration challenge,
4) Observations for the Baltic Basin,
5) Arctic monitoring and applications,
6) Atmospheric chemistry monitoring and applications, and
7) Monitoring climate and the oceans.

For detailed information and to view the First Announcement please visit the conference web page at http://bit.ly/EMSC201

Call for SPIE Optics and Photonics Earth Observing Systems XXIII conference to be held in San Diego Aug 19-23, 2018

by James J. Butler, NASA

The annual SPIE Optics and Photonics' Earth Observing Systems XXIII Conference will be held August 19-23, 2018 at the San Diego Convention Center, San Diego, CA.

The Earth Observing Systems XXIII conference welcomes the submission of papers over a wide range of remote sensing topics. Papers are solicited in the following general areas:

- Earth-observing mission studies including new system requirements and plans
- commercial system designs
- electro-optical sensor designs and sensitivity studies
- ultraviolet through thermal infrared, microwave, radar, and lidar remote sensing systems
- hyperspectral remote sensing instruments and methodologies
- instrument sub-system and system level pre-launch and on-orbit calibration and characterization
- vicarious calibration techniques and results
- satellite instrument airborne simulators
- techniques for enhancing data processing, reprocessing, archival, dissemination, and utilization
- conversion from research to operational systems
- on-orbit instrument inter-comparison techniques and results
- enabling technologies (optics, antennas, electronics, calibration techniques, detectors, and models)
- sensor calibration traceability, uncertainty, and pre-launch to on-orbit performance assessments.

The conference call for papers is available online at http://spie.org/OPO/conferencedetails/earth-observing-systems. Conference abstracts are due February 5, 2018, and proceedings manuscripts are due July 23, 2018.

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The Characterization and Radiometric Calibration for Remote Sensing (CALCON) Annual Meeting to be held June 18–21, 2018 at Utah State University, Logan, UT

by James J. Butler, NASA

Now in its 27th year, the Characterization and Radiometric Calibration for Remote Sensing (CALCON) Annual Meeting provides a forum for scientists, engineers, and managers to present, discuss, and learn about calibration, characterization, and radiometric issues within the microwave, IR, visible, and UV spectral ranges. Individuals developing measurement requirements for current and future sensor systems are encouraged to participate in the meetings to foster continuity and advancement within the community. CALCON attendance promotes interaction with other experts and helps close the gap between expectations and real-world experiences. Collaboration often results in the discovery of solutions to individual program challenges.
Meeting information is available at www.calcon.sdl.usu.edu. The deadline for the Call for Papers is February 28, 2018 with the website open for abstract submittal on January 2, 2018.

GSICS-Related Publications

Ahn, H., D. Shin, S. Lee, and C. Choi. 2017. 'Absolute Radiometric Calibration for KOMPSAT-3 AEISS and Cross Calibration Using Landsat-8 OLI'. *Journal of the Korean Society of Surveying, Geodesy, Photogrammetry and Cartography* 35 (4):291–302. doi:10.7848/ksgpc.2017.35.4.291.

Coburn, C. 2017. 'Temporal Dynamics of Sand Dune Bidirectional Reflectance Characteristics for Absolute Radiometric Calibration of Optical Remote Sensing Data'. *Journal of Applied Remote Sensing* 12 (1):012006. doi: 10.1117/1.JRS.12.012006.

Ebrahimi, H. 2016. 'On-Orbit Inter-Satellite Radiometric Calibration of Cross-Track Scanning Microwave Radiometers'. PhD Thesis, University of Central Florida. http://stars.library.ucf.edu/cgi/viewcontent.cgi?article=6250&context=etd.

Guo, Q., and X. Feng. 2017. 'In-Orbit Spectral Response Function Correction and Its Impact on Operational Calibration for the Long-Wave Split-Window Infrared Band (12.0 Mm) of FY-2G Satellite'. *Remote Sensing* 9 (6). doi:**10.3390/rs9060553.**

Kroodsma, R., D. McKague, and C. Ruf. 2017. 'Vicarious Cold Calibration for Conical Scanning Microwave Imagers'. *IEEE Transactions on Geoscience and Remote Sensing* 55 (2): 816–27. doi:10.1109/TGRS.2016.2615552.

Manninen, T., Riihelä, A., Heidinger, A., Schaaf, C., Lattanzio, A., Key, J., 2017, 'Intercalibration of Polar-Orbiting Spectral Radiometers Without Simultaneous Observations.' IEEE Trans. Geosci. Remote Sens., Vol. PP, No., 99, 1-13, doi: 10.1109/TGRS.2017.2764627.

McCorkel, J. 2017. 'Overview of the 2015 Algodones Sand Dunes Field Campaign to Support Sensor Intercalibration'. *Journal of Applied Remote Sensing* 12 (1):012003. doi:10.1117/1.JRS.12.012003.

Obata, K., S. Tsuchida, H. Yamamoto, and K. Thome. 2017. 'Cross-Calibration between ASTER and MODIS Visible to near-Infrared Bands for Improvement of Aster Radiometric Calibration'. *Sensors (Switzerland)* 17 (8). doi:10.3390/s17081793.

Shea, Yolanda L., Bruce A. Wielicki, Sunny Sun-Mack, and Patrick Minnis. 2017. 'Quantifying the Dependence of Satellite Cloud Retrievals on Instrument Uncertainty'. *Journal of Climate* 30 (17): 6959–76. doi:10.1175/JCLI-D-16-0429.1.

Sun, K., Liu, X., Huang, G., González Abad, G., Cai, Z., Chance, K., and Yang, K., 'Deriving the slit functions from OMI solar observations and its implications for ozone-profile retrieval,' Atmos. Meas. Tech., 10, 3677-3695,doi: 10.5194/amt-10-3677-2017, 2017.

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Submitting Articles to GSICS Quarterly Newsletter:

The GSICS Quarterly Press Crew is looking for short articles (~800 to 900 words with one or two key, simple illustrations), especially related to cal/val capabilities and how they have been used to positively impact weather and climate products. Unsolicited articles may be submitted for consideration anytime, and if accepted, will be published in the next available newsletter issue after approval/editing. Note the upcoming winter issue will be a general issue. Please send articles to manik.bali@noaa.gov.

With Help from our friends:

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