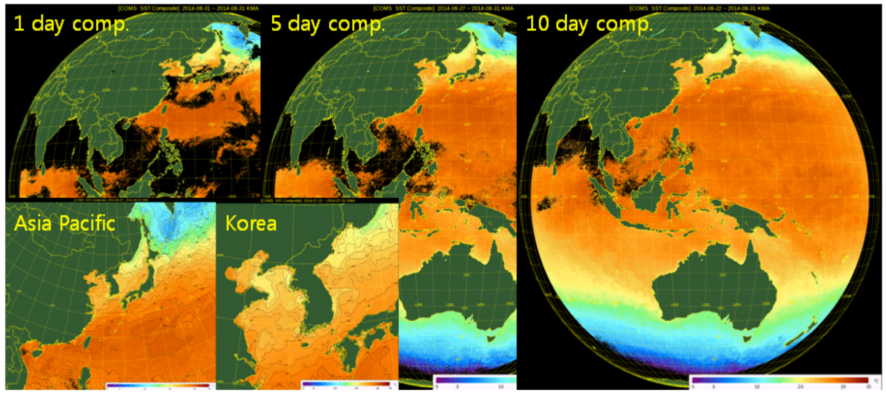
Volume 9 Number 1
2015
doi: 10.7289/V5ZP442R

GSICS Global Space-based Inter-Calibration System Quarterly

Newsletter – Spring 2015 Issue

Manik Bali, Editor

In This Issue



Images: Curtsey Chu-Yong @KMA show SST retrieved from COMS /MI measured TOA radiances.

Impact of GSICS -based Recalibration on Sea Surface Temperature retrieval from COMS/MI

By Eun-Bin Park, Dohyeong Kim, In-Chul Shin (KMA), Minji Seo and Kyung-Soo Han (Pukyong National University)

The Global Space-Based Inter-Calibration System (GSICS) is essential for generating global Thematic Climate Data Records (TCDR) with consistent accuracy. The National Meteorological Satellite Center (NMSC) of the Korea Meteorological Administration (KMA) uses GSICS methods to re-calibrate satellite radiances for the first Korean meteorological satellite (the Communication, Ocean, and Meteorological Satellite, COMS), which was launched on 27 June 2010.

The NMSC produces monthly and annual bias coefficients for the COMS/Meteorological Imager (MI) channels by using comparisons to a well-calibrated hyper-spectral instrument, the Infrared Atmospheric Sounding Interferometer (IASI) on board the MetOp-A satellite as reference for the re-calibration (Kim *et al*., 2015).
We analyzed the effects of the bias adjustments on the retrieved sea surface temperature (SST) using the COMS/MI infrared (IR) channels re-calibrated by the IASI. In the study, the SST was used as a Level-2 product because it is one of the global Essential Climate Variables (ECV) and is determined from the IR brightness temperature (BT) and solar zenith angle (SZA). A previous study was conducted to analyze the sensitivity of SST

doi: 10.7289/V5ZP442R

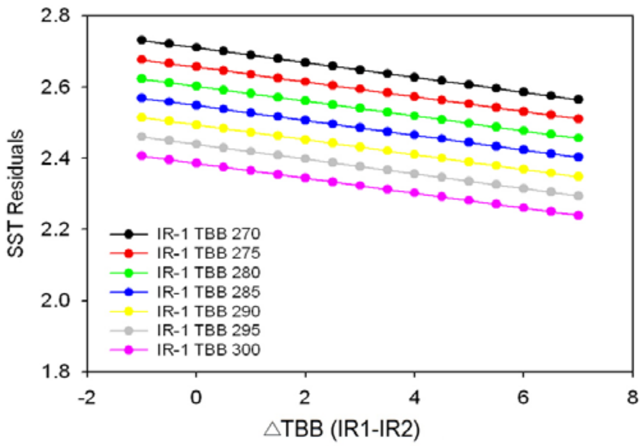


Figure 1. SST residuals according to ΔTBB and IR1 values (Park *et al*., 2013).

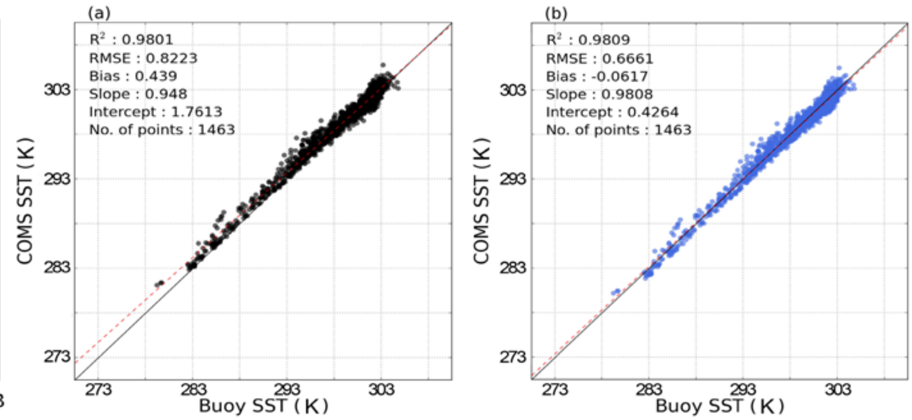


Figure 2. Scatter plots of SST and GTS buoy data (as reference data) during the daytime from April 2011–March 2012: original COMS SST (a); GSICS-corrected COMS SST (b) (Park *et al*., 2015).

according to whether COMS/MI was GSICS-corrected (Park *et al*., 2013). Figure 1 uses colors to illustrate part of the sensitivity analysis of the SST residuals (between the original SST and GSICS-corrected SST) according to the brightness temperature difference (BTD; 10.8–12.0 μm), with the 10.8-μm BT fixed from 270–300 K at 5 K intervals. The SST residuals range from 2.34 K (the last dot in the pink graph) to 2.71 K (the first dot in the black graph) and decrease with increasing ΔTBB (IR1–IR2).

In East Asia, the SST is generally 290~310 K, similar to an IR TBB > 290 K in Figure 1, where the SST residuals also have lower values. This means that the GSICS correction might not be effective when SST is generated using satellite IR data collected under limited conditions. Therefore, we investigated the effects of GSICS correction using all available COMS/MI IR data and the multi-channel SST (MCSST) algorithm. To apply the GSICS correction to the MCSST algorithm, we calculated new SST coefficients from multiple regression analysis using BTs of IR channels corrected by as independent variables and buoy data as dependent variables.

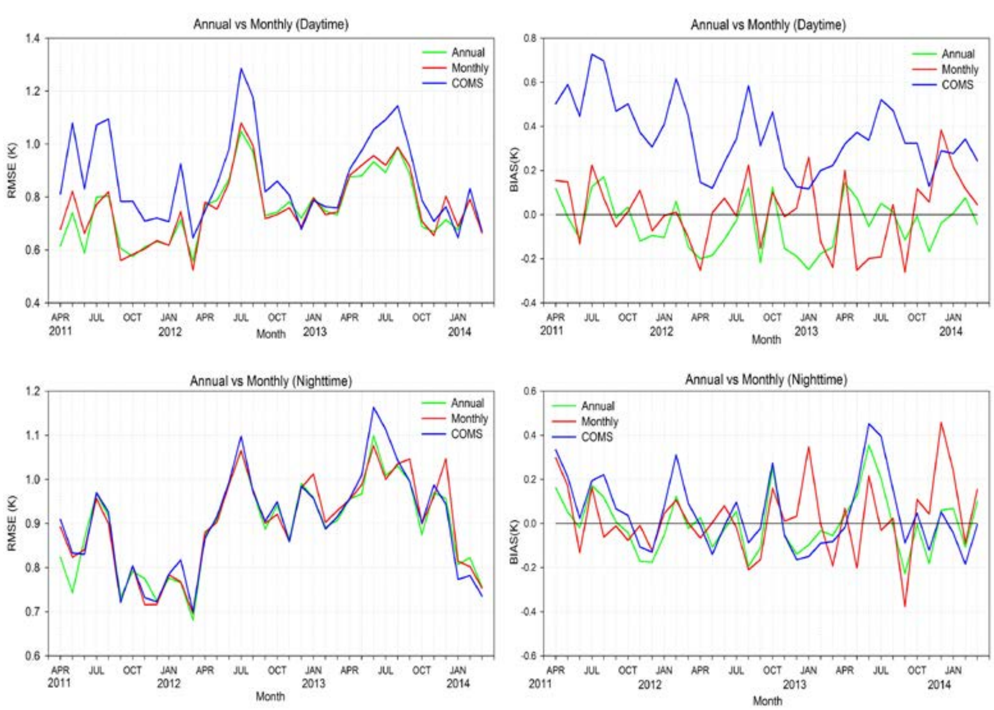


Figure 3. The RMSE (left) and bias (right) for the COMS SST and GSICS-corrected SST using both the annual and monthly calibration coefficients. Green: GSICS-corrected SST produced using the annual GSICS calibration coefficients. Red: GSICS-corrected SST produced using the monthly GSICS calibration coefficients. Blue: Uncorrected COMS SST

Based on the sensitivity analysis, the GSICS corrections were applied to the COMS/MI IR channels, and SST data were produced using the GSICS-corrected IR channels. Figure 2 shows the daytime original COMS SST (left) and GSICS-corrected COMS SST (right) for one year (April 2011–March 2012) with Global Telecommunications System (GTS) buoy data as reference in-situ data. The root mean square error (RMSE) and biases were improved remarkably, indicating that correcting the input data improved the accuracy of the satellite Level-2 product estimation (Park *et al*., 2015). Furthermore, the slope and intercept of the trend line (red dotted line) were close to one-to-one (black line) for SST values of 278.15–288.15 K. This confirmed that the GSICS correction of the IR data, which are also input data for satellite Level-2 products, affects the

Return to Page 1

accuracy of the other products. Correction of the IR channels through GSICS for a satellite Level-2 product (*i.e.*, SST in this study) were performed for three years (April 2011–March 2014); the resulting RMSE and bias (compared with in situ data) are shown for both the monthly and annual GSICS corrections in Figure 3. The coefficients were applied to the COMS/MI IR data.

The RMSE of the GSICS-corrected SST (green and red lines) improved remarkably compared with the original COMS SST (blue line) in June and July 2012 and 2013 during the daytime (upper left). At night (bottom left), the RMSE of the GSICS-corrected SST was similar to the original COMS SST, although in June 2013, the discrepancy is considerable.
The original COMS SST had a higher bias (upper right) than the GSICS corrected SST, which the GSICS-corrected SST biases are closer to 0 K for both corrected SSTs. In the bias graphs for both the daytime (upper right) and nighttime (bottom right) SST, the monthly GSICS-corrected SST showed a distinctive trend, because the monthly coefficients of the GSICS correction changed dynamically. The GSICS correction of IR data was performed successfully with the COMS/MI channels, and its effects on a Level-2 product (SST) were remarkable. We plan to produce a GSICS-corrected SST composite and apply GSICS to other Level-2 products, such as insolation, outgoing longwave radiation, and surface albedo.

The scope of evaluating the GSICS's impact on Level-2 products should be extended to the detection of inter-channel differences. The characterization of the full error covariance matrix of the GSICS coefficients would require to the generation of Level-2 products and to account for the correlation between their biases.

References

Kim, D., M. H. Ahn, and M. Choi, 2015, Inter-comparison of the infrared channels of the meteorological imager onboard COMS and hyperspectral IASI data. *Advances in Atmospheric Sciences*, 32:7, 1-13, DOI: 10.1007/s00376-014-4124-1.

Park, E. B., K. S. Han, J. H. Ryu, and C. S. Lee, 2013, Sensitivity analysis of satellite-retrieved SST using IR data from COMS/MI. *Korean Journal of Remote Sensing*, 29:6, 589-593, DOI:10.7780/kjrs.2013.29.6.1.

Park, E. B., K. S. Han, J. M. Yeom, C. S. Lee, J. H. Ryu, H. Kim, and D. Kim, 2015, Effects of GSICS correction on estimation of sea surface temperature using COMS data. *International Journal of Remote Sensing*, 36:4, 1026-1037, DOI: 10.1080/01431161.2015.1007249

Discuss the Article

Multi-Sensor Calibration Studies of AVHRR-Heritage Channel Radiances in the ESA-CLOUD-CCI project

By Karl-Göran Karlsson and Erik Johansson, Swedish Meteorological and Hydrological Institute (SMHI)

The European Space Agency (ESA) is currently running the Climate Change Initiative program (CCI) within which several projects explore the use of ESA's and other satellite agencies' sensors for climate change studies (Hollmann et al., 2013). In one of the projects, ESA-CLOUD-CCI, the aim is to apply and develop state-of-the-art cloud retrieval schemes (Stengel et al., 2013) to be applied to the longest available time series of cloud observations available from polar orbiting satellites with AVHRR or AVHRR-like sensors. This paper describes some initial work in ESA-CLOUD-CCI concerning attempts to evaluate existing differences between AVHRR radiances and radiances from a set of sensors all having AVHRR-like channels, namely the Moderate Resolution Imaging Spectroradiometer (MODIS), the Advanced Along-Track Scanning Radiometer (AATSR), and the MEdium Resolution Imaging Spectrometer (MERIS). The latter two instruments were on board the ESA ENVISAT platform with an observation period of ten years (2002-2012). Initial inter-comparisons of the involved AVHRR-heritage channel radiances were made over a three-year period (2007–2009).

Using Aqua-MODIS as reference, AVHRR (NOAA-18), AATSR, and MERIS channel radiances were evaluated using the simultaneous nadir (SNO) approach. Figure 1 illustrates the coverage and distribution of realized SNO observations. Naturally, the ability to match Aqua-MODIS with global observations from an afternoon orbit is good while for morning orbits matches are only achievable around the latitude of 70 degrees on both the hemispheres.

doi: 10.7289/V5ZP442R

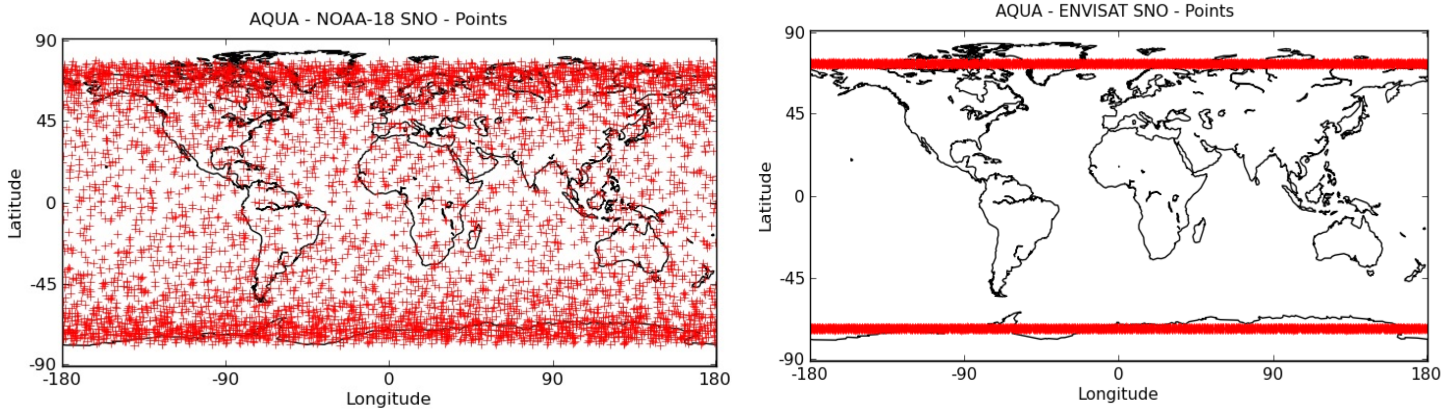


Figure 1. Distribution of realized SNO match-ups within 10 minutes in the period 2007-2009 for NOAA-18 AVHRR and AQUA MODIS (top-left) and for ENVISAT AATSR/MERIS and AQUA MODIS (top-right). Notice that for MERIS and for AATSR visible channels only half of the match-ups are useful (i.e., available during daytime conditions).

In a study like this it is essential to take precautions for not having the interesting signal masked out by noise which otherwise could be caused by inhomogeneous clouds and surfaces, remaining temporal differences, geolocation errors *etc*. Thus, the following restrictions were applied to the data to ensure homogeneous targets and sufficient illumination at target locations:

1. Standard deviations of radiances within individual match-up targets were limited to 1%.

2. Solar zenith angles should be less than 70°.

3. Normalized reflectances should be greater than 10%.

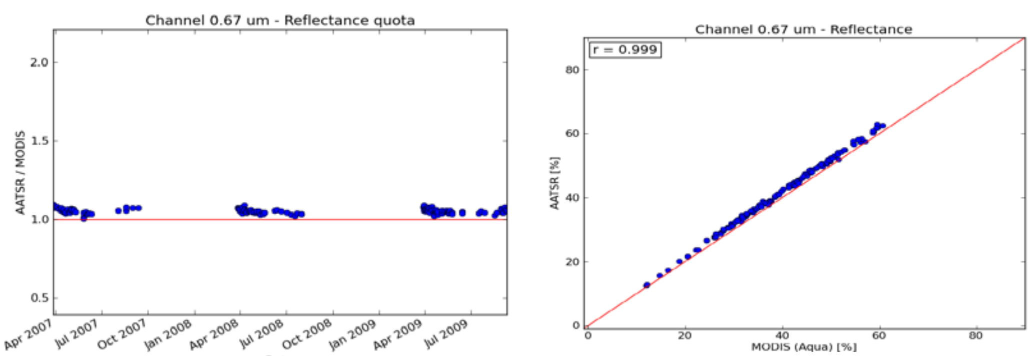


Figure 2. Inter-comparison of Northern Hemisphere (explaining data gaps) normalized reflectance factors against MODIS for the AVHRR-heritage channel at 0.6 µm for AATSR. Left panel shows results expressed as reflectance factor quotas over the full time series and right panel shows results expressed as a scatter plot.

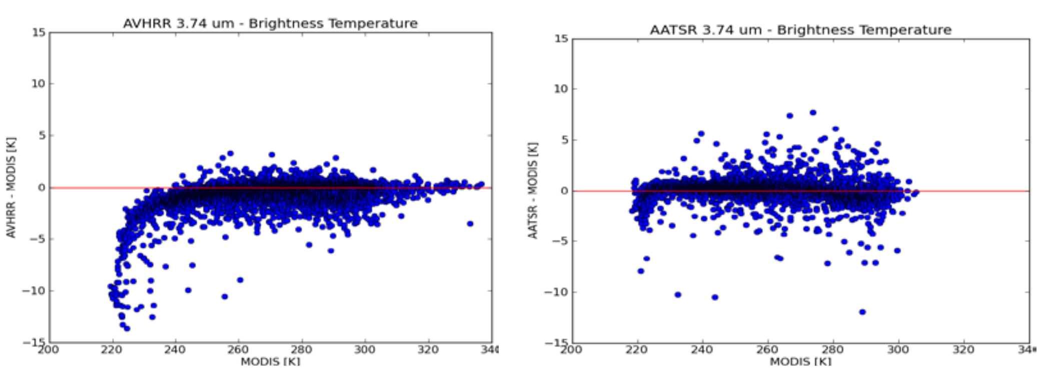


Figure 3. Inter-comparison of brightness temperatures against MODIS for the AVHRR-heritage channel at 3.7 µm for AVHRR (left) and AATSR (right). Results are expressed as brightness temperature differences as a function of MODIS brightness temperatures

Figure 2 shows an example of final results after applying these restrictions for the inter-comparison of MODIS and AATSR normalized reflectance factor at 0.6 µm. Results indicate an absolute difference of about 5 % for the normalized reflectance factor in this spectral band.

Figure 3 shows an example from the inter-comparison of brightness temperatures in infrared channels (here for the 3.7 µm channel). **Results showed generally good** agreement between all studied sensors and channels but remarkable differences were seen for very cold target temperatures where the different sensor responses as well as different radiometric resolutions lead to different results. Final results for the AVHRR and AATSR sensors are summarized in Tables 1-2.

Return to Page 1

Table-1: Reflectance factor quotas or brightness temperature quotas for AVHRR with respect to MODIS (AVHRR/MODIS) deduced from SNO inter-comparisons in the period of 2007–2009.

AVHRR Channel	Wavelength interval (nm)	Reflectance Factor Quota (Channels 1,2) or Brightness Temperature Quota (Channels 3b,4,5)
1	580-680	0.984
2	725-1,000	0.985
3b	3,550-3,930	0.998
4	10,300-11,300	1
5	11,500-12,500	0.999

Table-2: Reflectance factor quotas or brightness temperature quotas for AATSR with respect to MODIS (AATSR/MODIS) deduced from SNO inter-comparisons in the period of 2007–2009.

AATSR Channel	Central Wavelength (nm)	Reflectance Factor Quota (Channels 2–4) or Brightness Temperature Quota (Channels 5–7)
2	665	1.05
3	865	1.029
4	1,610	0.965
5	3,740	1
6	10,850	1
7	12,000	0.999

For the MERIS channels at 665 nm and 865 nm, the corresponding reflectance factor quotas were 0.971 and 0.965, respectively

A final remark is that the seemingly large deviations observed for the AATSR visible channels are most likely linked to small remaining differences in spectral response functions. This gives a slightly different appearance of Earth surfaces and clouds for the matched targets which is difficult to compensate for. Thus, we have no reason to suspect the existence of any remaining systematic artificial bias in AATSR radiances, especially considering that these have been extensively monitored for many years in ESA CAL/VAL activities (see Smith and Cox, 2013).

A more comprehensive discussion of these results is found in Karlsson and Johansson, 2014.

References

Hollmann, R., and Coauthors, 2013, The ESA Climate Change Initiative: Satellite Data Records for Essential Climate Variables, Bull. Amer. Meteor. Soc., 94, Issue 10 (October 2013), 1541–1552. doi:10.1175/BAMS-D-11-00254.1.

Karlsson, K.-G., and Johansson, E., 2014, Multi-Sensor Calibration Studies of AVHRR-Heritage Channel Radiances Using the Simultaneous Nadir Observation Approach, Rem. Sens., **Vol. 6**, Issue 3, 1845-1862; doi:10.3390/rs6031845.

Smith, D.L., Cox, C.V., 2013, (A)ATSR solar channel on-orbit radiometric calibration. IEEE Trans. Geosci. Remote Sens. **Vol. 51**, 1370–1382.

Stengel, M., *et al*., 2013, The Clouds Climate Change Initiative: Assessment of state-of-the-art cloud property retrieval schemes applied to AVHRR heritage measurements, Remote Sens. Environ., doi: 10.1016/j.rse.2013.10.035.

Discuss the Article

Effects of Sand Dune Ridge Alignment on Surface BRF over the Libya-4 CEOS Calibration Site

By Yves Govaerts, Rayference

Introduction

The Libya-4 desert area is one of the most important bright desert CEOS pseudo-invariant calibration sites because of its size and radiometric stability. This site is intensively used for radiometer drift monitoring, sensor intercalibration and as an absolute calibration reference based on simulated radiances traceable to the SI standard. The Libya-4 morphology is composed of oriented sand dunes shaped by dominant winds. The effects of sand dune spatial organization on the surface bidirectional reflectance factor have been analyzed using a 3D radiative transfer model (RTM).

The Libya-4 CEOS Calibration Site

The Libya-4 CEOS calibration site, centered at 28.55◦ N and 23.39◦ E in the Great Sand Sea, is composed of spatially-organized sand dunes.

doi: 10.7289/V5ZP442R

The global digital elevation model (DEM) derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) observations has been used for this sensitivity analysis. This model has a 30m spatial resolution. An analysis of the ASTER DEM reveals that the area exhibits a complex multiple-scale spatial organization. The central part of this domain consists of large-scale north-south transverse dunes, *i.e.*, ridges of sand with a steep face in the downwind side. The northeast part of the area has the lowest altitude, populated with the crescent sand dune (barchan) type.

BRF Simulations

Raytran, a 3-D RTM, has been used to analyze the effects of sand dune spatial organization on surface Bidirectional Reflectance Factor (BRF; Govaerts and Verstraete, 1998). This model has been extensively evaluated and has proven to be one of the most accurate surface RTMs (Widlowski et al, 2013). Sand dune ridge alignment effects on surface BRF as a function of the Solar Azimuth Angle (SAA) are analyzed. Figure 1 shows surface BRF polar plots over the 20 km side region-of-interest for five different SAA values, *i.e.*, 90°, 135°, 180°, 225° and 270°. Solar Zenith Angle (SZA) is set to 50° in this experiment. A visual inspection of these polar plots reveals the overall reflectance increase in the backscattering signature resulting from sand dune topography independent of the SAA value (Govaerts, 2015). This simulation has been performed for a sand reflectance magnitude equal to 0.3. The effects of sand dune ridge alignment on surface BRF are particularly visible when Sun Azimuth Angle (SAA) is equal to 180°.

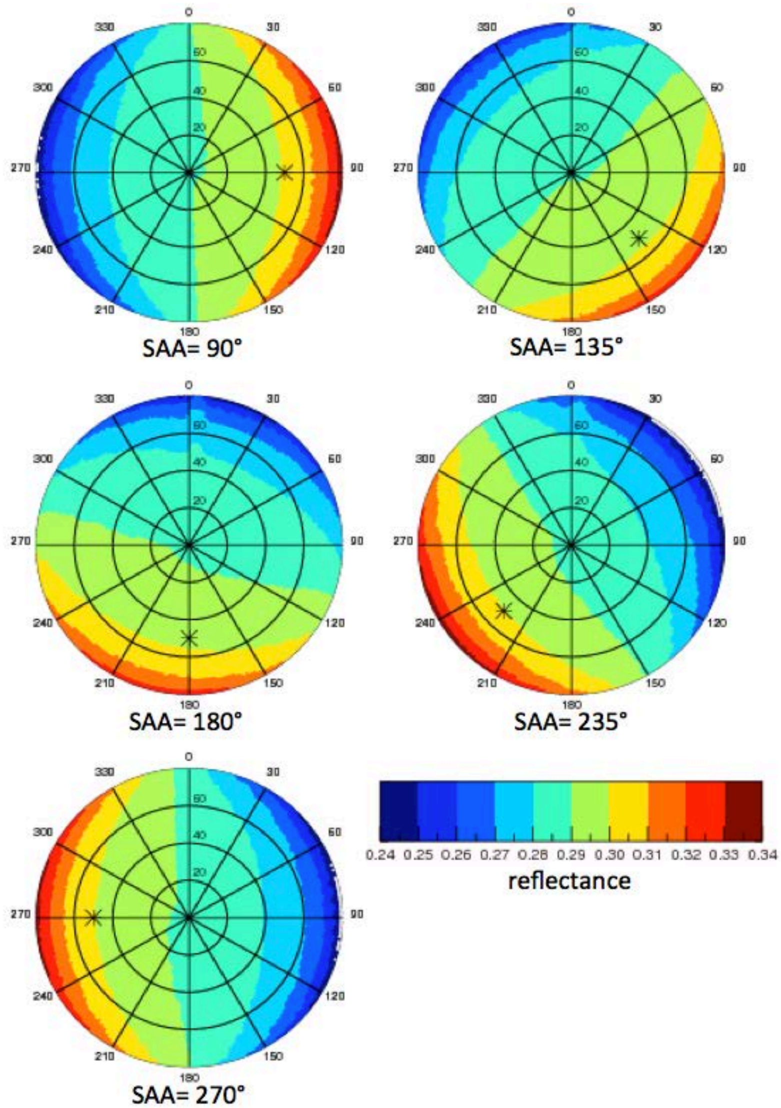


Figure. 1 Polar plots of Raytran surface BRF simulations over Libya-4 for the 20 × 20 km region of interest and SZA = 50°. Sand reflectance is equal to 0.3. Circles represent view/illumination zenith angles, and polar angles represent azimuth angles with a 0° azimuth pointing to the north. The ∗ symbol indicates the Sun position.

In the case of simulations performed with RTM that are only dependent on the actual relative azimuth angle between the Sun and viewing directions, as is the case with the 1D model, the BRF values of the left and right side part of the hemisphere with respect to the principal plane are symmetrical. Such symmetry is clearly not observed in the present case. Additionally, a visual comparison between plots for SAA equal to 135° and 225° shows distinct differences between the two illumination conditions. These two SAA configurations correspond to typical mid-morning and mid-afternoon illumination geometry for Sun synchronous polar orbiting radiometers.

Conclusions

Results show that sand dunes generate more backscattering than forward scattering at the surface. Solar azimuth position has an effect on the surface reflectance field, which is more pronounced for high Solar zenith angles. Such 3D azimuthal effects should be taken into account to decrease the simulated radiance uncertainty over Libya-4 below 3% for wavelengths larger than 600 nm.

Acknowledgement

This work has been funded by the EC FP7 Quality Assurance for Essential Climate Variables (QA4ECV) project for the preparation of the Copernicus Climate Service.

References

Govaerts, Y.M, 2015: Sand dune ridge alignment effects on surface BRF over the Libya-4 CEOS calibration site, *Sensors*, 15, 3453-3470; doi:10.3390/s150203453.

Govaerts, Y.M. and M. M. Verstraete, 1998: Raytran: a Monte Carlo ray tracing model to compute light scattering in three-dimensional heterogeneous media. *IEEE Trans. Geosci. Remote Sens.*, 36, 493–505.

Widlowski, J. L. et al., 2013: The fourth radiation transfer model intercomparison (RAMI-IV): Proficiency testing of canopy reflectance models with ISO-13528. J. *Geophys. Res. Atmos.*, 118, 6869–6890

Discuss the Article

Cross-Calibration of Charged Particle Measurements in Geostationary Orbit

By Juan V. Rodriguez, CIRES and NOAA NCEI

Because of the hazards that trapped charged particles and solar energetic particles (SEPs) pose to spacecraft and humans in space, NOAA has flown instruments in geostationary orbit to monitor them since the launch of the Synchronous Meteorological Satellite (SMS) in 1974. The predecessors to the NOAA Space Weather Prediction Center (SWPC) developed real-time solar radiation storm and radiation belt alerts that use these GOES observations (http://www.swpc.noaa.gov/noaa-scales-explanation).

The new particle instruments on GOES-R represent the first design change for such GOES instruments since GOES-8 (launched 1994) and the first thorough re-design since GOES-4 (launched 1980). In order to maintain the consistency of SWPC's alerts, the new instruments must be cross-calibrated with the GOES 13-15 instruments. The GOES-R cross-calibrations face two major challenges: (1) observing the same fluxes and (2) accounting for different instrument responses. The second challenge is roughly analogous to that addressed by the GSICS cross-calibration between the broad-band Spinning Enhanced Visible and Infrared Imager (SEVIRI) and the high-resolution Infrared Atmospheric Sounding Interferometer (IASI) (Hewison, 2013). This article reviews briefly how these two challenges can be met.

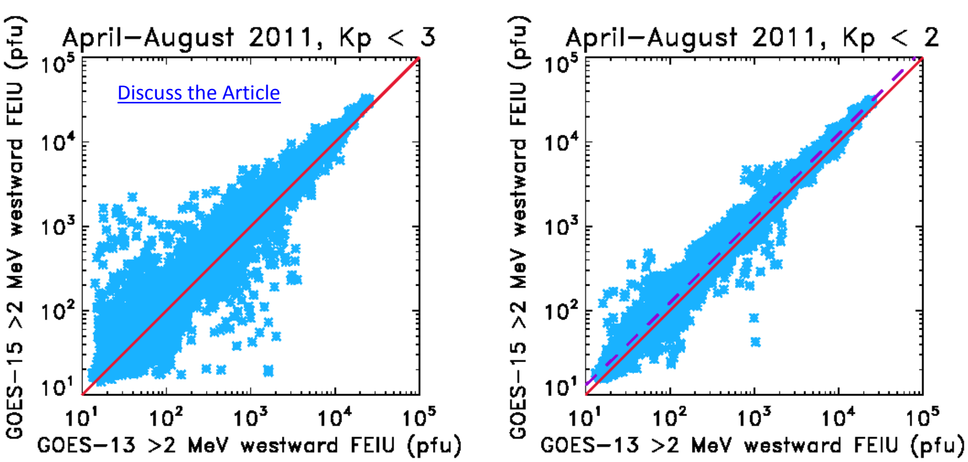


Figure 1. Scatter plots from cross-calibration of the GOES-13 and GOES-15 E > 2 MeV channel performed on data measured from April to August 2011, for (left) Kp < 3 and (right) Kp < 2. GOES-15 reports the same fluxes as 23% greater than GOES-13 (Meredith et al., 2015).

Unless one is comparing two co-boresighted instruments, one must use physics to identify periods when two instruments are observing the same number fluxes (particles / (cm^2 sr s keV)). In general, this involves an application of Liouville's theorem, which states that the phase space density (the ratio of number flux to the square of momentum) of charged particles is constant along a given trajectory in a slowly-varying magnetic field. For charged particles trapped in the Earth's magnetic field, one approach to observing phase space densities on the same trajectories is to compare observations from geostationary satellites in close proximity under quiet geomagnetic conditions (Onsager et al., 2004).

This approach has been used to cross-calibrate two GOES radiation belt electron measurements separated by an hour or less in local time. Figure 1 shows a cross-calibration of the GOES-13 and GOES-15 E > 2 MeV electron channels during April – August 2011 when GOES-13 was at ~75°W and GOES-15 was at ~90°W. Based on the planetary K-index (Kp) of geomagnetic activity, the cross-comparison that include more disturbed periods exhibited more scatter. Using this method, Meredith et al. (2015) have shown that the E > 2 MeV electron measurements on GOES-8 through GOES-15 have agreed to within 29%. For MeV SEPs, Liouville's theorem is formulated in terms of a geomagnetic cutoff: at any point, each direction of arrival is associated with a rigidity (momentum per unit charge) above which all external fluxes can access that point and below which no external fluxes can access that point (e.g., Kress et al., 2013, and references therein). Therefore, in order to compare two SEP observations, both must be above their geomagnetic cutoffs. Under these conditions, the energy spectra are the same and the angular distributions are isotropic at both locations. Our method for identifying such conditions is based on the observation that cutoff rigidities are reduced during periods of high solar wind dynamic pressure (the pressure imparted by the solar wind plasma on the magnetosphere). This allows the proximity requirement to be relaxed for SEP cross-calibration. The resulting low-scatter cross-calibrations show that the solar proton measurements on GOES-8 through GOES-15 agree to within 20% (Rodriguez et al., 2014). Along with the results of Meredith et al. (2015), this represents a good record for the current GOES particle detectors, whose relatively simple designs were chosen to give repeatable performance (R. Grubb, private communication, 2014).

The second challenge, of comparing two instruments with different energy channels, is a classic inversion problem involving the retrieval of a differential energy spectrum of number fluxes from a set of integral equations (one per channel). One inversion approach is to derive an effective energy for each channel. Sandberg et al. (2014) derived effective energies for six broad GOES channels from a cross-calibration with twenty-three channels from the IMP-8 Goddard Medium Energy Experiment (GME) in the 4-500 MeV range. While this approach is possible with the historical GOES measurements, there is currently no high-resolution SEP measurement like GME operating near Earth (IMP-8 operated from 1973 to 2006). Therefore, the GOES-R effective energies need to be derived from the integral equations, either beforehand or iteratively as part of a calibration/validation or product algorithm. As with the inversion of atmospheric remote sensing measurements, the solution needs to be constrained with prior knowledge of realistic natural variability. If the angular responses of the two instruments differ significantly, then the angular distribution of the fluxes may also need to be retrieved by inverting the integral equations (Hartley et al., 2013) before an accurate cross-comparison can be performed. Despite these challenges, the planned on-orbit cross-calibrations of the GOES-R particle instruments rest upon a foundation of well-validated techniques. Their use will increase the confidence placed by the user community on these space weather observations

References

Hartley, D. P., Denton, M. H., Green, J. C., Onsager, T. G., Rodriguez, J. V., and Singer, H. J., 2013, Case studies of the impact of high-speed solar wind streams on the electron radiation belt at geosynchronous orbit: Flux, magnetic field, and phase space density, J. Geophys. Res. Space Physics, **Vol. 118**, 6964-6979, 10.1002/2013JA018923.

Hewison, T. J., 2013, An evaluation of the uncertainty of the GSICS SEVIRI-IASI intercalibration products,IEEE T. Geoscience and Remote Sensing, **Vol. 51**, 1171-1181, 10.1109/TGRS.2012.2236330.

Kress, B. T., Rodriguez, J. V., Mazur, J. E., and Engel, M., 2013, Modeling solar proton access to geostationary spacecraft with geomagnetic cutoffs, Adv. Space Res., **Vol. 52**, 1939–1948, 10.1016/j.asr.2013.08.019.

Meredith, N. P., Horne, R. B., Isles, J. D., and Rodriguez, J. V., 2015, Extreme relativistic electron fluxes at geosynchronous orbit: Analysis of GOES E > 2 MeV electrons. Space Weather, **Vol. 13**, 170–184, 10.1002/2014SW001143.

Onsager, T. G., Chan, A. A., Fei, Y., Elkington, S. R., Green, J. C., and Singer, H. J., 2004, The radial gradient of relativistic electrons at geosynchronous orbit, J. Geophys. Res., **Vol. 109**, A05221, 10.1029/2003JA010368.

Rodriguez, J. V., Krosschell, J. C., and Green, J. C., 2014, Intercalibration of GOES 8–15 solar proton detectors, Space Weather, **Vol. 12**, 92–109, 10.1002/2013SW000996.

Sandberg, I., Jiggens, P., Heynderickx, D., and Daglis, I. A., 2014, Cross calibration of NOAA GOES solar proton detectors using corrected NASA IMP-8/GME data, Geophys. Res. Lett., **Vol. 41**, 4435–4441, 10.1002/2014GL060469.

Discuss the Article

doi: 10.7289/V5ZP442R
GSICS Quarterly: Winter Issue 2015 Volume 9, No. 1, 2015

News in this Quarter

By Manik Bali, NOAA

This year, the biennial NOAA satellite conference was held in the Marriot Hotel, Greenbelt Maryland , USA, from April 27 –May 1, 2015. Scientists from over 40 countries participated in the conference. They included members from NOAA, NASA, Department of Defense, Environment Canada, EUMETSAT, and the Hydro-meteorological Services of countries in North, Central and South America, the Caribbean, and Asia.

The conference attempted to provide a platform to bring together a spectrum of providers of LEO and GEO satellite data , producers of satellite products and application developers. The agenda consisted of sessions that were based on fourteen broad themes:

1. **Current and Future GOES - Are You Ready?**
2. **GOES-R sees the Earth**
3. **JPSS - Building on the Success of S-NPP**
4. **Use of S-NPP**
5. **JPSS Products and Dissemination: How to Access Data (current and future satellites)**
6. **GOES-R Products**
7. **Product Distribution Systems**
8. **Product Distribution Services**
9. **Logistics Update (Grand Ballroom)**
10. **Education and Training (what's out there today and planned for the future)**
11. **International Perspectives on Training and User Access to Imagery and Products**
12. **Other NOAA Space Programs: 2015 to 2020+**
13. **Frequency Matters**
14. **Meeting our Nation's Challenges: Socio Economic Benefits of Environmental Satellites**

In addition to oral sessions, members used poster sessions to display the latest advancements in satellite products and their use

In the opening session Wenjian Zhang from WMO (1.10) outlined the vision of the WMO Integrated Global Observing System (WIGOS) space based component up to the year 2040. In the talk, he emphasized that with an increased participation from members, GSICS would be a key component in the future of WIGOS.

Topics of interest to GSICS community included: Recalibration and Merging of SSU observations for stratospheric temperature trend studies (Poster 1-15, Zou et al,), Adaptive Trending and Limit Monitoring Algorithm for GOES-R ABI Radiometric Parameters(Poster 1-27, Li et al.) , Comparison of Different Calibration Approaches in S-NPP CrIS Full Spectral Resolution Processing (Poster 1-34, Wang et al.) Soumi NPP CrIS Radiometric Calibration Stability Assessment: A Perspective from Two Years' Inter-Comparison with AIRS and IASI (Poster 1-52, Chen et al.).

The oral and poster presentations gave a good overview of current and future Earth Observation missions of NOAA. Applications of the current operational NOAA polar mission (S-NPP) were highlighted by several presenters.

Fiona Hilton (Smith) , from UKMO, stated that CrIS is currently used in weather forecasting suits globally and highlighted the considerably low noise displayed by the instrument as compared to IASI and AIRS (Talk 2.4a). Lawrence E Flynn, Director of the GSICS Coordination Center provided a comprehensive description of the Atmospheric Chemistry Products from OMPS: Validation and Applications (Talk 2.3d) . Dr. Flynn described the Nadir and Limb profiler products retrieved from OMPS measurements and highlighted that the on-board monitoring systems of the OMPS are providing good characterizations of the time-dependent changes of the Ozone.

Mitch Goldberg the JPSS Program chief scientist, pointed out that CrIS could be evaluated as a global reference by communities such as GSICS and gave further insight into the performance of the CrIS instrument (Talk 2.3c).

For the future NOAA missions the conference not only discussed the advances in development of future missions (Session 2.1 on GOES-R) but also how the future mission data would be disseminated to the scientists and users (session 3.1). Tim Schmit (Talk 2.2a) observed that the imager onboard GOES-R is expected to provide continuity to the current GOES missions. It is designed to have, an image quality two times better than previous GOES. In addition it is designed to have three times the number of imaging bands, four times the spatial resolutions and five times the coverage rate (preparations would be made by using a special GOES-14 1-minute data pathfinder). This advanced imager will also provide greatly improved coverage over South America.

A key conclusion that emerged from the conference discussions was the urgent need to enhance or replace current receiving equipment and basic processing software as the next generation of satellites begins operation. It was highlighted that environmental future environmental satellites would provide satellite technological, scientific, educational and training opportunities, and direct readout and re-broadcast services would raise awareness of upcoming enhancements and prepare for their use.

Discuss the Article

Highlights of 2015 annual GRWG/GDWG Meeting

By Tim Hewison (EUMETSAT), Manik Bali (NOAA), Peter Miu (EUMETSAT) and Masaya Takahashi (JMA)

This year's meeting of the GRWG and GDWG was hosted by the Indian Meteorology Department in New Delhi, India, on 16-20 March 2015. This was the first time the meeting has been held in India, so attendance from IMD and ISRO was excellent, extending to other interested organizations, such as the National Centre for Medium-Range Weather Forecasting (NCMRWF). Nine of the GSICS Member agencies were represented in person at the meeting, while two other agencies were able to join remotely for some sessions.

After an impressive opening ceremony, including speeches from the Minister and Secretary of the Indian Ministry for Earth Sciences, where we were generously hosted, the meeting, the meeting started with a *Mini Conference*. This allowed attendees to highlight a range of activities of interest to the calibration community, including plans to establish satellite observations which can be directly traced to SI standards, and the importance of these to climate applications. Updates were also provided on the recently launched Himawari-8 and INSAT-3D satellites and their calibration.

The Mini Conference was followed by plenary session the next day, including agency reports to update members about their recent GSICS activities. Presentations on Digital Object Identifier or doi, What are GSICS products ?, and Requirements for RAC/NRTC products, initiated exciting discussions directly addressing GSICS products creation and their maintenance.

The GSICS Coordination Center (GCC) report informed members of the current maturity status of GSICS products and invited members contribute to the Newsletter and be a part of the Newsletter Editorial Board. GCC also suggested ways to optimize and streamline and optimize the GSICS Procedure for Product Acceptance (GPPA). Following the plenary the meeting split into separate sessions for the Research and Data working group.

GSICS Research Working Group

The GRWG sessions reported progress with GSICS Corrections for the infrared channels of current geostationary imagers, the first of which are expected to become the first operational GSICS products this year (from NOAA, EUMETSAT and JMA), and new products are expected to be ready to enter demonstration mode at three agencies (ISRO, CMA and KMA). These GSICS products will allow all current geostationary imagers from active GSICS members to be calibrated to a common reference for the first time. Plans were outlined to perform comparisons of the corrected level 1 data from this constellation on the geostationary ring, and analyze the impact of these corrections on level 2 products derived from them. This will be the focus for further cooperation within GSICS, as well as interaction with the user community.

Counterpart GSICS products for the visible channels of geostationary imagers were also discussed. The first of these, which use Deep Convective Clouds (DCCs) as invariant transfer targets is nearly ready for implementation to generate demonstration datasets, and methods to address the observed seasonal variations in DCC reflectances were presented. The afternoon session of the VIS/NIR sub-group concentrated on the outcomes of the Lunar Calibration Workshop, hosted at EUMETSAT in December 2014. These lead to actions needed to develop inter-calibration products, using the Moon as a transfer target - in particular addressing spectral differences between instruments, and accounting for oversampling in their different sampling strategies. This will become the focus of the sub-groups work going into 2016 and offers the potential to address all channels in the VIS/NIR band for instruments capable of observing the full lunar disc.

GSICS Data Working Group

In the Data Working Group sessions, more than 15 topics such as repository for source codes, metadata standards for VIS and Microwave GSICS Products, satellite event logging and updates of the GSICS THREDDS server configuration were discussed. The most important outcome is that agencies operating the THREDDS servers (EUMETSAT, NOAA and CMA) agreed to mirror the products across servers. This enables us to maintain a stable data preservation system. The server configurations will be updated to ingest new GSICS products (e.g., GSICS Prime Correction and VIS/NIR GSICS correction) in the near future. The GSICS bias plotting tool will also be updated to support final changes to the GSICS products before operations and new products.

To support the GRWG lunar calibration activities, the group discussed how to provide user access to the GSICS Implementation of the ROLO (GIRO) model and the GSICS Lunar Observation Dataset (GLOD). EUMETSAT is taking the lead on this issue. International collaboration on establishing product format validation tool among CMA, EUMETSAT, IMD, JMA, and KMA is expected to be useful not only for the GDWG work but also for the validation of local implementation of the GIRO by each GPRC.

In the wrap-up session of the meeting, Tim Hewison (GRWG Chair) and Manik Bali from GCC announced that the 2015 GSICS Users Workshop would be held in Toulouse France on 22 September 2015 and it would be collocated with the Annual EUMETSAT Satellite Conference.

The closing ceremony was also dignified by the presence of the Director General of IMD and the Secretary General of WMO, recognizing the growing importance of GSICS.

Discuss the Article

doi: 10.7289/V5ZP442R
GSICS Quarterly: Winter Issue 2015 Volume 9, No. 1, 2015

Announcements

Doheyong Kim new Chair of the GSICS Research Working Group.

By Jérôme Lafeuille, WMO

In its annual meeting recently held in Boulder, Colorado the Executive Panel nominated Doheyong Kim as Chair of the GSICS Research Working Group (GRWG). Dohyeong has been vice-chair of GRWG for the past five years. He is currently Senior Researcher of the Satellite Planning Division of the National Meteorological Satellite Center of Korea Meteorological Administration (KMA/NMSC), a position he has held for the past eight years. He worked for most of his professional career on atmospheric radiation. His primary research areas are the retrieval of radiation budget from surface-based and satellite-based measurements and radiative transfer modeling. He is now in charge of satellite sensor development, i.e. the next generation geostationary and low earth orbit satellites of KMA, and of their sensor calibration. Dohyeong hopes to exploit this expertise as Chair of GSICS Research Working Group and looks forward to collaborating with the members of this major working group.

Dohyeong replaces Tim Hewison who has served as GRWG Chair diligently for the past six years. The Panel expressed its warm thanks to Tim for the key role he has played in the development of GSICS through his active leadership over these years. Tim will continue to serve GRWG as Vice-Chair in replacement of Xiangqian (Fred) Wu from NOAA who had been the first GRWG Chair before being Vice-Chair. The Panel also nominated Xiuqing (Scott) Hu from CMA as the second Vice-Chair.

Joint Workshop on Uncertainties at 183 GHz to be Held on 29-30 June, 2015 in Paris, France

By Stephen English (ECMWF), Hélène Brogniez (LATMOS), Jean François Mahfouf (Météo-France) and Sophie Cloché (CRNS/IPSL)

LATMOS, ECMWF, Météo-France and IPSL under the auspices of both the ITWG and WCRP-GEWEX activities and with the sponsorship of Megha-Tropiques are co-organizing a joint workshop on uncertainties at 183 GHz. This workshop will be held on 29-30 June, 2015, at Pierre et Marie Curie University, Paris, France.

Recognizing the importance of radiometric observations at 183 GHz as a key source of humidity information for global and regional analysis, weather forecasts and climate monitoring the workshop will consider questions such as:

- How can we assess the absolute and relative accuracy of references such as radiosondes?
- How can we assess errors in the comparison between in-situ and space-borne measurements ?
- What uncertainty arises from the difference in the time/space scales of these measurements?
- What is the current best estimate of uncertainty in spectroscopic lineshapes and lineshape parameters ?
- What is the uncertainty arising from undetected clouds?
- How good is the absolute calibration of the instruments?

The workshop will publish a summary of conclusions, recommendations and actions. These will be presented to the ITWG at the 20th International TOVS Study Conference (October-November 2015), and summarized in a GEWEX newsletter. Selected key recommendations will also be passed onto the International Radiation Commission and, where appropriate.

Further information about the workshop can be found at the website: http://mw183.sciencesconf.org/

doi: 10.7289/V5ZP442R

GSICS-Related Publications

Chang, T. et al., 2015: Post launch Calibration Update of MetOp-B AVHRR Reflective Solar Channels Using MetOp-A, *IEEE TGRS,* pp. 2286-2294

Dai, L. And T, Che.,2015: Inter-calibrating SMMR, SSM/I and SSMI/S to improve the consistency of snow depth data products in China. *EGU General Assembly* pp.

Gao, H. et al.,2015: Cross-Calibration of the HSI Sensor Reflective Solar Bands Using Hyperion Data *IEEE TGRS.* **Vol.53 No.7** 6, 4127-4137.

Guo, Y et al., 2014: Calibration and validation of microwave humidity and temperature sounder onboard FY-3C satellite. *Chinese Journal of Geophysics.*, **Vol.58 No.1**, 20-31.

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 are received for consideration anytime, and if accepted, will be published in the next available newsletter issue after approval/editing. Note the upcoming spring issue will be a general issue. Please send articles to manik.bali@noaa.gov.

With help from our friends:

The GSICS Quarterly Editor would like to thank Doheyong Kim for the lead article in this issue. Thanks are also due to Jerome Lafeuille (WMO), Fangfang Yu(NOAA), Tim Hewison (EUMETSAT) and Lawrence E. Flynn(NOAA) for reviewing the articles in this issue.