JPSS Instrument lead GSICS cross calibration activities

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1.Background

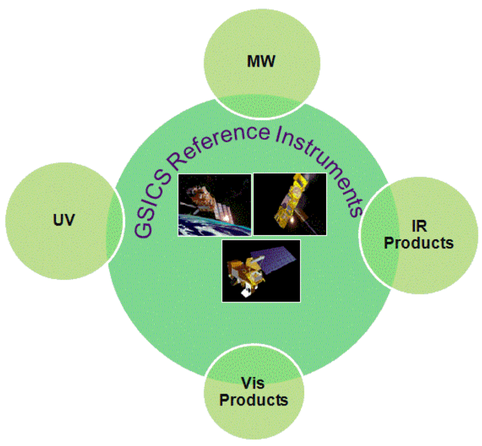
The Joint Polar Satellite System (JPSS) program has emerged as one of the core earth observing missions of the US since its launch in 2012 with the ATMS, OMPS, CrIS and VIIRS onboard the S-NPP taking observations in the Microwave, Ultraviolet, Infrared and Visible wavelenghts. Measured radiances are concurrently being used for NWP and Climate Applications.

More recently the JPSS instruments are aquiring global acceptability in terms of being used for product generation and also for using as references for monitoring the in-orbit status of their GEO instruments belonging to satellite agencies across the world. Within the framework of the Global Space Based Inter-calibration System (GSICS), the GSICS Coordination Center hosted by NOAA/STAR is currently desiging a procedure wherein satellite instruments (such as some of the JPSS instruments) could be accepted as reference instruments by (GSICS) satellite agencies that are spead across 14 member countries.

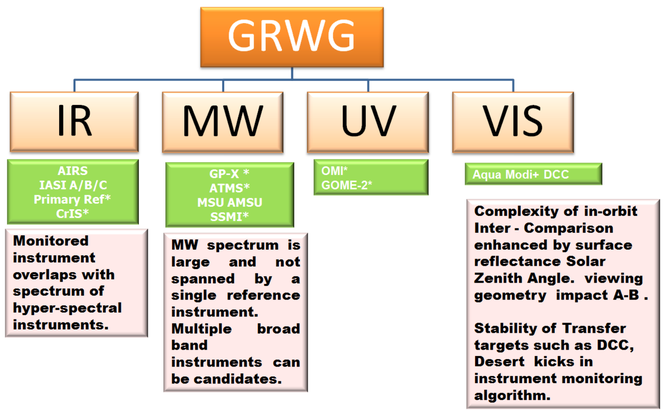
This goal of this poster is to showcase the acceptance procedure and also to demonstrate some of the uses of the the JPSS instruments not only within the NOAA but also satellite agencies (such as KMA, CMA, that are members of the Global Space Based Inter-Calibration System framework)

2. Procedure for identification of a GSICS reference Instrument

The GSICS Coordination Center at NOAA/STAR has been tasked by the GSICS (comprising 14 Satellite agencies) community to identify a process by which in-orbit instruments can be designated as a GSICS reference instruments. These reference instruments are used to monitor target instruments that fly concurrently. GCC has proposed a selection process that can be used to select reference instruments from a range of in-orbit flying instruments. This process first attempts to strike a balance between User Expectations and availability of candidate instruments and then takes into consideration Routine Monitoring of the In-Orbit health status of the instrument(such as carried out at ICVS), routine CAL/VAL activities of the instrument and an instrument scoring scheme proposed by EUMETSAT (Hewison 2015) to help arrive at a decision.



Candidate reference instruments and their use in GSICS



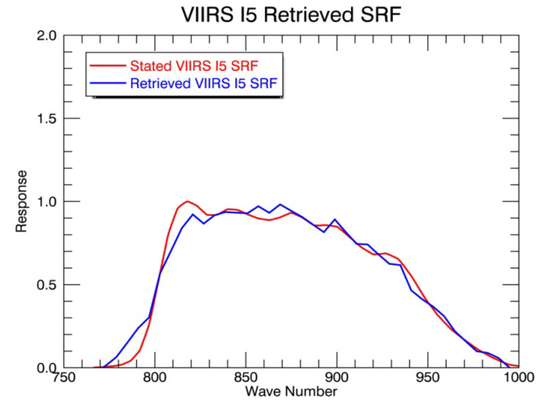
Candidate reference instruments and their use in GSICS

Proposed selection criterion takes into consideration.

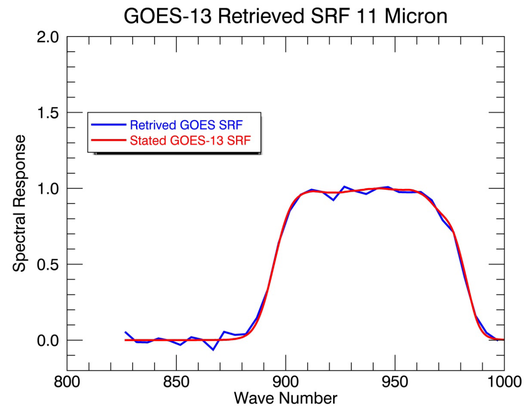
1. The instrument and Channels sub group wishes to monitor.
2. The method/s they would employ to monitor(eg. single or blended references, use transfer target or not stability criterion).
3. In addition consider scoring proposed by Tim (if there are more than 1 candidate instruments).
4. Comparison of Instrument design specification (Pre-launch testing) with In-orbit behavior.
5. May consider if in-orbit status of key parameters of Candidate Ref instrument are monitored and available to users (eg. ICVS).
6. Take inputs from Info (global coverage, eq. cross time etc) related to instrument available (eg OSCAR)

3. Applications of JPSS/CrIS as a reference instrument

A novel method has been developed that can determines SRF by inter-comparing with a Hyperspectral instrument such as CrIS/IASI



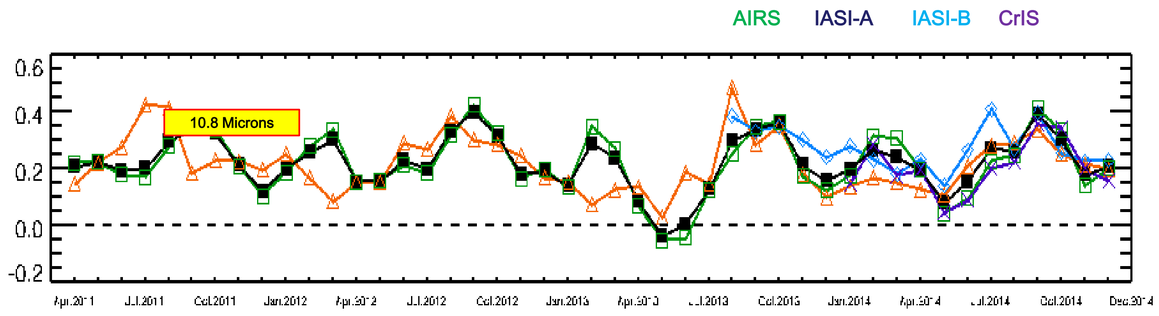
VIIRS I5 SRF retrieved by intee comparing with CrIS radiances



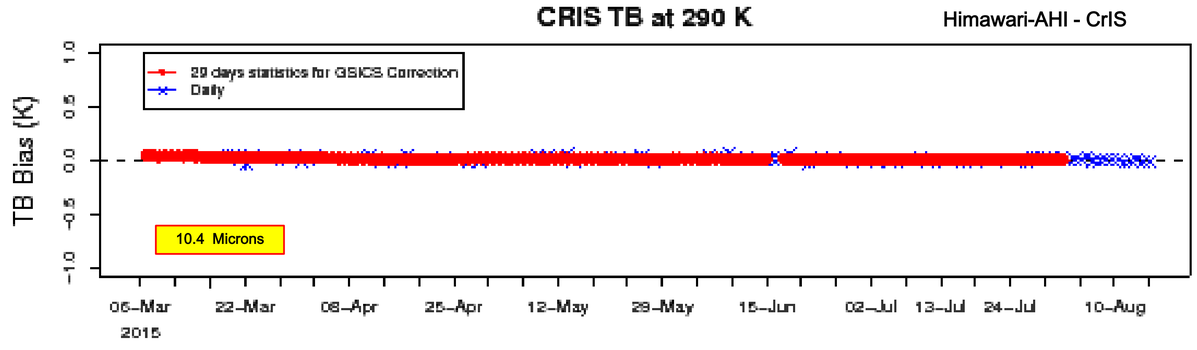
GOES-13 SRF retrieved by intee comparing with IASI radiances

4. Global Use of JPSS/CrIS in inter-calibrating in-orbit instruments.

Japanese Meteorological Agency-

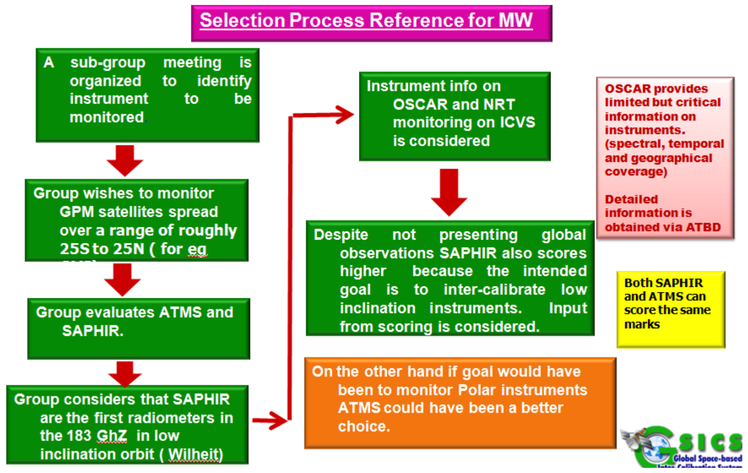


Korean Meteorological Agency-



VIIRS I5 SRF retrieved by intee comparing with CrIS radiances

3. Scoring scheme for selecting Reference Instrument



Selection Process proposed by GCC NOAA for selecting a reference instrument. The scoring scheme (below) is a part of it.

Example of Proposed Scoring Scene for GSICS Re-Analysis Correction for Meteosat Second Generation IR Channels

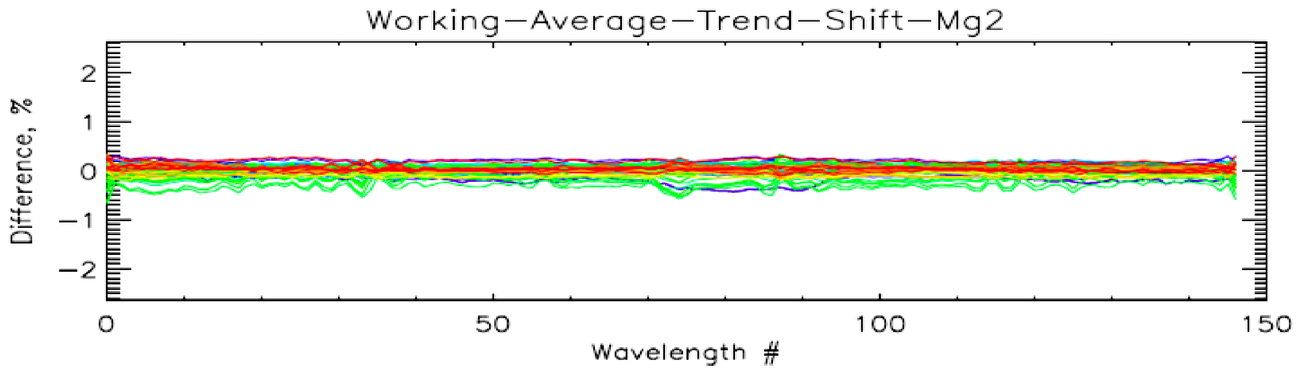
		Threshold		Saturation			MetopA/IASI				
	Unit	Min	Max	Min	Max	Weight	Min	Max	Compliant	%Perfect	Score
Data Availability		1	1	1	1	1	1	1	Pass		
Date Range	Year	2013	2013	2006	2030	100	2007	2020	Pass	63%	63.4
Geographic Coverage: Lat	deg	-10	10	-90	90	2	-90	90	Pass	100%	2.0
Geographic Coverage: Lon	deg	-10	10	-180	180	2	-180	180	Pass	100%	2.0
Dynamic Range	K	270	300	180	330	5	180	310	Pass	67%	3.3
Spectral Range	cm-1	746	2564	650	2800	10	645	2760	Pass	92%	9.2
Geometric Range: VZA	deg	5	15	0	90	2	0.5	55	Pass	72%	1.4
Geometric Range: VAA	deg					0			Pass		0.0
Geometric Range: SZA	deg					0			Pass		0.0
Geometric Range: SAA	deg					0			Pass		0.0
Geometric Range: Pol	deg					0			Pass		0.0
Diurnal Coverage	hr	9	10	0	12	5	7.8	11.2	Pass	36%	1.8
Field of View	km		300		3	1		12	Pass	97%	1.0
Number of obs/day	/d					0			Pass		0.0
Number of Collocations/da	/d	1		10000		5	30000		Pass		0.0
Geolocation accuracy	km		10		0.1	10		3.3	Pass	68%	6.8
Polarisation knowledge	deg								Pass		0.0
Radiometric Stability	K/yr		1		0.001	10		0.05	Pass	95%	9.5
Orbital Stability	hr/yr		12		0.1	0		0.001	Pass	100%	0.0
Radiometric Noise	K		10		0.1	1		0.15	Pass	99%	1.0
Spectral Resolution	cm-1		100		0.5	10		0.25	Pass	100%	10.0
Spectral Stability	cm-1/yr		2		0.01	10		0.000002	Pass	100%	10.0
SBAF Uncertainty	K		1		0.001	0		0.15	Pass	85%	0.0
Absolute Calibration Acc	K		1		0.001	10		0.05	Pass	95%	9.5
Inter-channel calibration	K								Pass		0.0
Traceability									Fail		
Documentation									Pass		
Community adoption									Pass		
Total						**184**			**96%**	**71%**	**130.9**

Scoring Scheme proposed by Time Hewison(EUMETSAT) for selecting a reference instrument

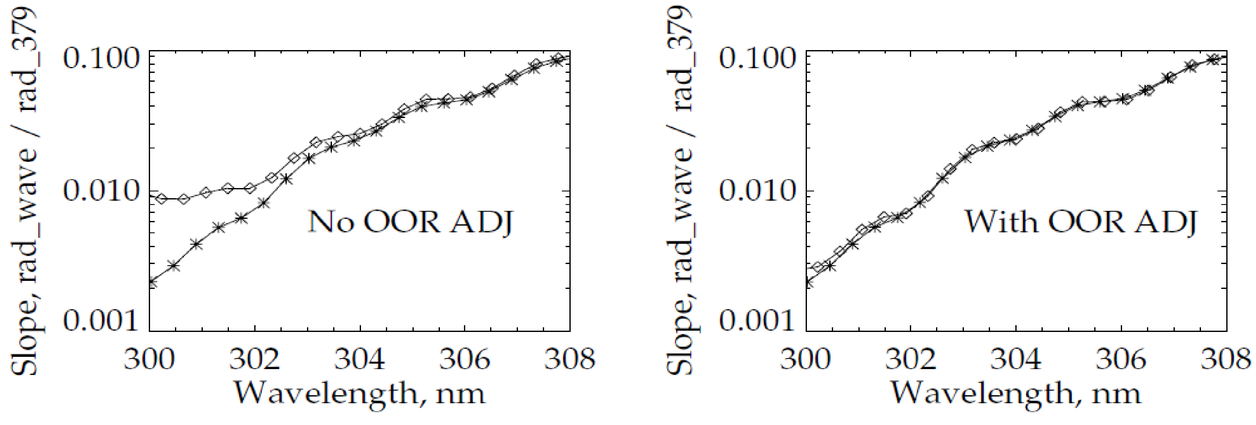
5. Ozone Mapping Profiler Suite (OMPS)

The Ozone Mapping Profiler Suite (OMPS) onboard the JPSS is the flagship instrument for monitoring global Ozone patterns, which is one of the key indicators used to measure climate change. Sensitive in the UV wave length the onboard health of the instrument needs to be constantly monitored to ensure high quality of UV measurements. The key monitoring requirements place by the ozone community are

1. Pre-Flight Laboratory calibration of the instrument
2. Performance of dual diffusers for OMPS for Solar Measurements (Diffuser and instrument degradation)
3. Ability to track wavelength through measurement based methods.
4. Performance Requirements (Are they good enough?)
   Comparisons to forward model results using ??
5. Internal consistency
6. Chasing orbits
7. Targets
8. SNO



Above OMPS NP Working Solar residuals after fits



The figures above give the values of the slopes for linear fits of the variations of the radiances at wavelengths from 300 nm to 308 nm fit with the variations at 379 nm.The plots on the left-hand-side show the results for the uncorrected version and the plots on the right-hand-side show the corrected version

Acknowledgement: Authors would like to thank Denis Tremblay of CrIS tSDR eam for his help on the usage of CrIS instrument