Global Space-based Inter-Calibration System (GSICS)

Progress and Directions

Mitchell D. Goldberg,

GSICS Exec Panel Chair
NOAA/NESDIS
Chief, Satellite Meteorology and Climatology Division

Mitch.Goldberg@noaa.gov

Organizations contributing to GSICS

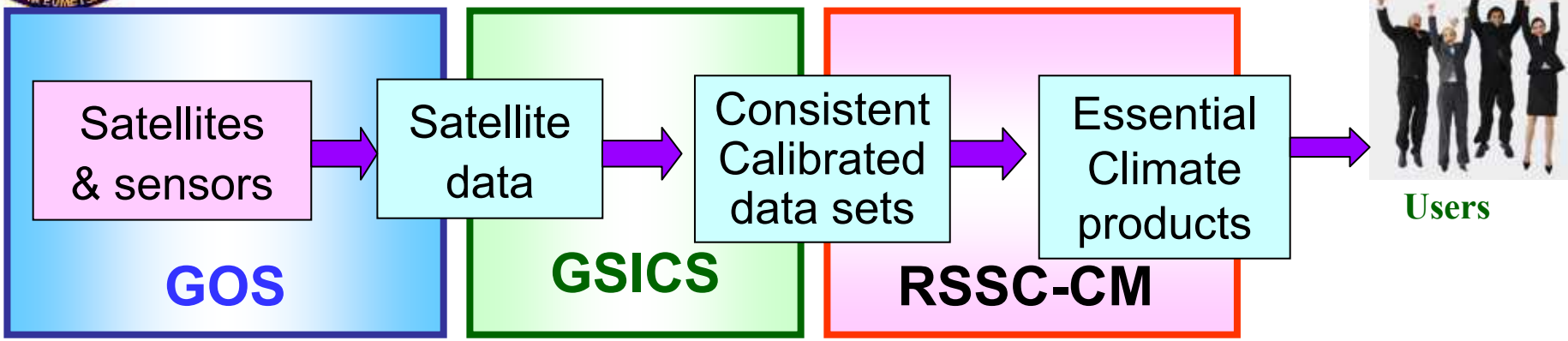
- NOAA
- NIST
- NASA
- EUMETSAT
- CNES
- CMA
- JMA
- KMA

GSICS current focus is on the intercalibration of operational satellites, and makes use of key research instruments such as AIRS and MODIS to intercalibration the operational instruments

GSICS Objectives

- To improve the use of space-based global observations for weather, climate and environmental applications through operational inter-calibration of satellite sensors.
  - Observations are well calibrated through operational analysis of instrument performance, satellite intercalibration, and validation over reference sites
  - Pre-launch testing is traceable to SI standards
- Provide ability to re-calibrate archived satellite data with consensus GSICS approach, leading to stable fundamental climate data records (FCDR)

RSSC to maximize data usage



- Regional/Specialized Satellite Centres
  - Mobilize effort and expertise in some centres (or distributed virtual centres) to provide quality-controlled products following agreed specifications
  - Initial scope is Climate Monitoring (RSSC-CM) responding to GCOS requirements
  - A number of potential participating agencies
  - Implementation Plan being developed by EUMETSAT for adoption in November 07

2007 Activities

- Annual Operating Plan
- Two GRWG meetings (chair, Fred Wu)
  - Consensus algorithms for LEO to GEO intercalibration
- GDWG (chair, Volker Gaertner)
  - Data management issues, metadata
- Commissioned GSICS Website and routine LEO to LEO intersatellite calibration, with performance reports at NESDIS
- Intercomparisons of AIRS and IASI

Global Space-Based Inter-Calibration System

- HOME
- PARTNERS
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- PERSONNEL
- NEWSLETTERS
- SCIENCE PAGES
- SEMINARS
- MEETINGS
- PUBLICATIONS
- LINKS
- OPPORTUNITIES

Mission:

Assure high-quality, inter-calibrated measurements from the international constellation of operational satellites to support the GEOSS goal of increasing the accuracy and interoperability of environmental products and applications for societal benefit.

Goals:

The primary goal of GSICS is to improve the use of space-based global observations for weather, climate and environmental applications through operational inter-calibration of the space component of the WMO World Weather Watch (WWW) Global Observing System (GOS) and Global Earth Observing System of Systems (GEOSS). The basic GSICS strategies to achieve this goal are:

- To establish a GSICS Virtual Library to efficiently share information, software and data relevant to calibration;
- To build collaborations ensuring that each satellite instrument meets specifications by making pre-launch tests traceable to SI standards;
- To improve on-orbit calibration of satellite instrument observations by means of an integrated cal/val system, including instrument performance monitoring, inter-satellite/inter-sensor calibration, lunar and stellar calibration, vicarious calibration and validation with reference sites;
- To establish a distributed research component and a plan for research to operations transition;
- To build collaborations to retrospectively re-calibrate archive satellite data using the operational inter-calibration system in order to make satellite data archives worthy for NWP forecasts and climate studies.

Satellite Inter-Calibration

LEO - LEO

- Microwave Sounder
- Microwave Imager
- Infrared Sounder
- VIS/IR Imager
- Method and Result Documentation

GEO -LEO

- Infrared Sounder
- VIS/IR Imager
- Method and Result Documentation

Microwave Sounder

● :Active ● : Inactive

	NOAA 9	NOAA 10	NOAA 11	NOAA 12	NOAA 14	NOAA 15	NOAA 16	NOAA 17	NOAA 18	Metop-A	Aqua
NOAA 9		●	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NOAA 10			●	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NOAA 11				●	●	N/A	N/A	N/A	N/A	N/A	N/A
NOAA 12					●	●	●	N/A	N/A	N/A	N/A
NOAA 14						●	●	●	●	●	●
NOAA 15							●	●	●	●	●
NOAA 16								●	●	●	●
NOAA 17									●	●	●
NOAA 18										●	●
Metop-A											●
Aqua											

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Intersatellite Instrument Characteristics

POES NOAA18 AMSU-A and Metop-A AMSU-A

AMSUA

Tb Bias vs. Date

AMSU (57.252 GHz)

Show Plot

Tb Bias vs. Tb

AMSU (57.252 GHz)

Show Plot

Individual Inter-cal Event Distribution Statistics Table

AMSU (57.252 GHz)

Show Table

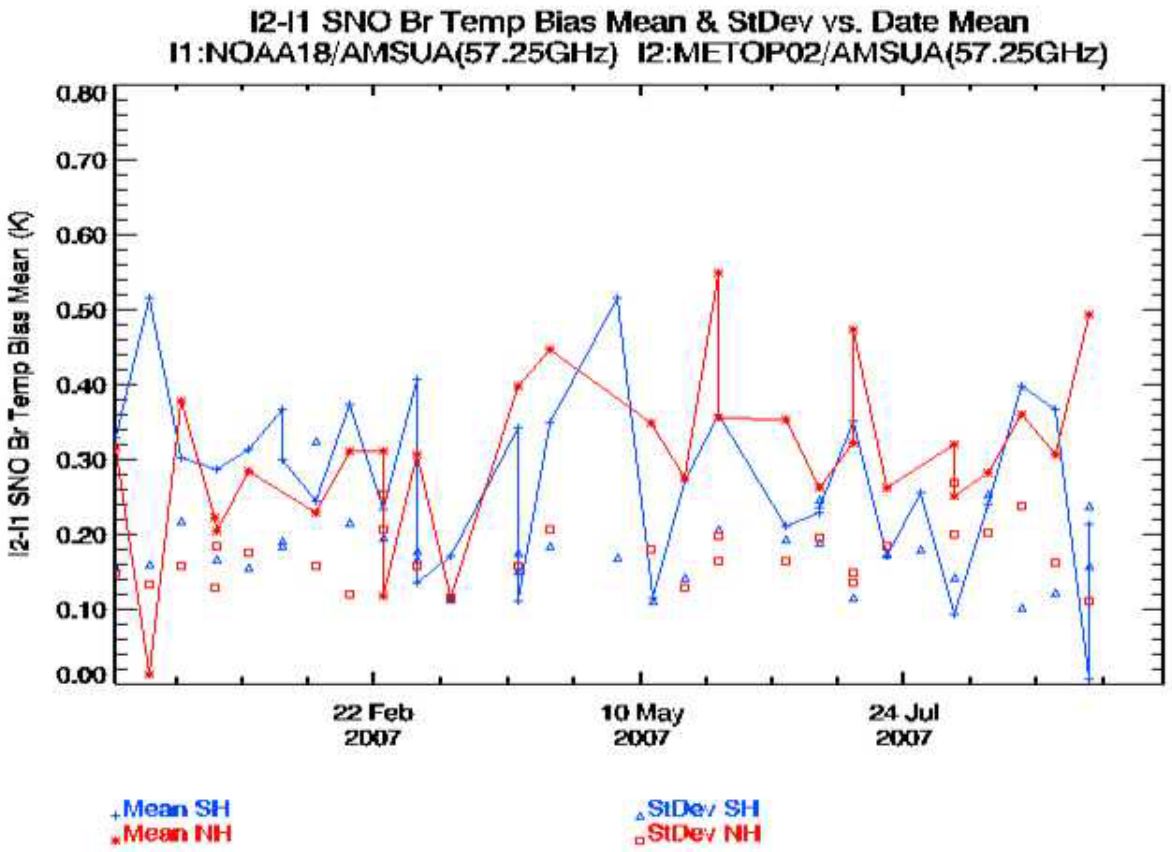
Individual Inter-cal Event Covariance Statistics Table

AMSU (57.252 GHz)

Show Table

Ensemble Statistics Table

Show Table



LEO-LEO SNO Ensemble Statistics

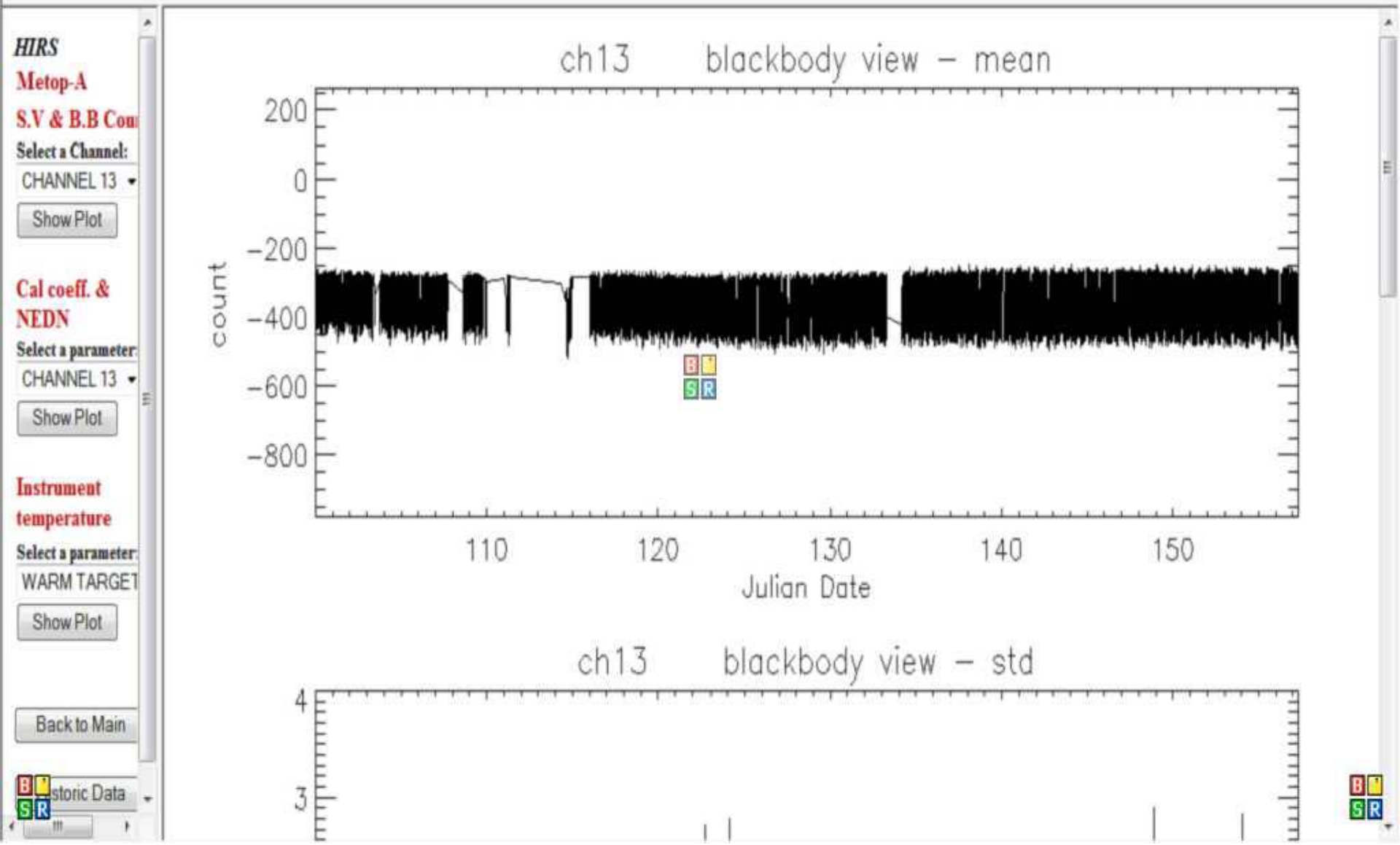
Satellite 1: NOAA18 Satellite 2: METOP02

Instrument 1: AMSUA Instrument 2: AMSUA

Ch_I1	Ch_I2	Parameter	Hemis	#SNOs	Average	StandDev	GaussDist	Sig_Avg	Trend_Param(t)	Sig_Trend	Slope_Param(BrT/Refl)	Sig_Slope	Avg_I1(BrT/Refl)	Avg_I2(BrT/Refl)	Avg_delTime	Avg_delLoc
00001	00001	BrTempBias	South	31	0.504	0.941	Yes	no@99%	-2.930	no@99%	-1.6185E-02	no@99%	202.244	202.748	15.3	19.69
00002	00002	BrTempBias	South	31	0.473	0.966	No	no@99%	-2.190	no@99%	-1.8961E-02	yes@99%	201.121	201.595	15.3	19.69
00003	00003	BrTempBias	South	32	-0.200	0.536	Yes	no@99%	-5.857	yes@99%	5.1997E-03	no@99%	218.958	218.759	15.3	19.69
00004	00004	BrTempBias	South	32	-0.226	0.201	Yes	yes@99%	-2.822	yes@99%	6.3014E-03	yes@99%	230.785	230.559	15.3	19.69
00005	00005	BrTempBias	South	32	-0.230	0.165	No	yes@99%	-1.698	yes@99%	9.3951E-03	yes@99%	230.518	230.288	15.3	19.69
00006	00006	BrTempBias	South	32	0.078	0.094	No	yes@99%	-1.668	yes@99%	7.4439E-03	yes@99%	223.174	223.251	15.3	19.69
00007	00007	BrTempBias	South	32	0.291	0.084	No	yes@99%	-0.649	no@99%	1.8069E-03	no@99%	216.976	217.267	15.3	19.69
00008	00008	BrTempBias	South	32	0.187	0.094	Yes	yes@99%	0.907	yes@99%	-2.0781E-03	no@99%	213.513	213.700	15.3	19.69
00009	00009	BrTempBias	South	32	0.273	0.116	No	yes@99%	-1.634	yes@99%	1.6123E-03	no@99%	210.095	210.369	15.3	19.69
00010	00010	BrTempBias	South	32	0.369	0.138	No	yes@99%	-0.530	no@99%	4.9849E-04	no@99%	210.686	211.054	15.3	19.69
00011	00011	BrTempBias	South	32	0.366	0.147	Yes	yes@99%	-1.314	yes@99%	5.1872E-04	no@99%	213.685	214.051	15.3	19.69
00012	00012	BrTempBias	South	32	0.230	0.145	No	yes@99%	-1.222	no@99%	4.8267E-04	no@99%	221.238	221.469	15.3	19.69
00013	00013	BrTempBias	South	32	0.130	0.222	Yes	no@99%	-2.263	yes@99%	-8.9412E-04	no@99%	233.044	233.174	15.3	19.69
00014	00014	BrTempBias	South	32	0.023	0.380	No	no@99%	1.305	no@99%	-3.1174E-03	no@99%	246.620	246.643	15.3	19.69
00015	00015	BrTempBias	South	32	0.089	1.104	Yes	no@99%	-9.018	no@99%	-2.0378E-03	no@99%	203.449	203.537	15.3	19.69
00001	00001	BrTempBias	North	29	0.278	1.493	No	no@99%	12.175	no@99%	-6.1263E-03	no@99%	214.128	214.406	16.0	19.67
00002	00002	BrTempBias	North	29	0.244	1.593	No	no@99%	13.848	no@99%	-8.5765E-03	no@99%	213.032	213.276	16.0	19.67
00003	00003	BrTempBias	North	29	-0.350	0.503	No	yes@99%	-6.933	no@99%	-1.4771E-02	yes@99%	234.872	234.521	16.0	19.67
00004	00004	BrTempBias	North	29	-0.099	0.136	Yes	yes@99%	-2.446	no@99%	-3.2917E-03	no@99%	245.023	244.924	16.0	19.67
00005	00005	BrTempBias	North	29	-0.124	0.108	Yes	yes@99%	-1.005	no@99%	-3.1786E-03	no@99%	241.009	240.886	16.0	19.67
00006	00006	BrTempBias	North	29	0.103	0.077	No	yes@99%	-0.262	no@99%	8.5038E-04	no@99%	230.615	230.719	16.0	19.67
00007	00007	BrTempBias	North	29	0.336	0.072	No	yes@99%	0.565	no@99%	1.1509E-03	no@99%	224.128	224.464	16.0	19.67
00008	00008	BrTempBias	North	29	0.207	0.086	Yes	yes@99%	0.205	no@99%	3.3178E-04	no@99%	221.386	221.593	16.0	19.67
00009	00009	BrTempBias	North	29	0.304	0.113	No	yes@99%	1.940	no@99%	6.5323E-04	no@99%	219.825	220.129	16.0	19.67
00010	00010	BrTempBias	North	29	0.346	0.114	Yes	yes@99%	1.512	no@99%	1.3000E-03	no@99%	221.043	221.389	16.0	19.67
00011	00011	BrTempBias	North	29	0.403	0.148	Yes	yes@99%	1.642	no@99%	-1.7633E-04	no@99%	224.738	225.141	16.0	19.67
00012	00012	BrTempBias	North	29	0.247	0.239	Yes	yes@99%	0.201	no@99%	-2.4013E-03	no@99%	232.296	232.543	16.0	19.67
00013	00013	BrTempBias	North	29	0.195	0.284	No	yes@99%	-3.925	no@99%	-1.2264E-02	yes@99%	243.009	243.204	16.0	19.67
00014	00014	BrTempBias	North	29	0.102	0.541	No	no@99%	-5.361	no@99%	-2.5504E-02	yes@99%	253.781	253.884	16.0	19.67
00015	00015	BrTempBias	North	29	0.123	1.217	No	no@99%	-22.803	no@99%	-2.2769E-02	no@99%	222.534	222.657	16.0	19.67

32 SNOs, BIAS 0.27 K, STDV 0.116 …….. Avg Time Dif 15.3 secs, Avg Dist 19.7 km

Metop-A/HIRS instrument trending (experimental)



2008 Activities

- Commission intercalibration of MTSAT, MSG, GOES and FY2 Infrared Imagers with IASI and AIRS.
  - Routine intercomparisons between MSG (SEVIRI) and AIRS/IASI at EUMETSAT
  - Routine intercomparisons between GOES and AIRS/IASI at NESDIS
  - Routine intercomparisons between MTSAT and AIRS/IASI at JMA
  - Routine intercomparisons between FY2 and AIRS/IASI at CMA

Integrated Cal/Val System Architecture

Calibration Opportunity Prediction

Data Acquisition Scheduler

Calibration Opportunity Register (CORE)

Raw Data Acquisition for Calibration Analyses

Stored Raw Data for Calibration Analyses

SNO/ SCO Rad. Bias and Spectral Analysis	Calibration Parameter Noise/ Stability Monitoring	RTM Model Rad. at Calibration Reference Sites	Inter-sensor Bias and Spectral Analysis	Earth & Lunar Calibration	Geolocation Assessment (Coastlines, etc.)

Assessment Reports and Calibration Updates

GSICS Outcome

- Coordinated international intersatellite calibration program
- Exchange of critical datasets for cal/val
- Best practices/requirements for monitoring observing system performance (with CEOS WGCV)
- Best practices/requirements for prelaunch characterisation (with CEOS WGCV)
- Establish requirements for cal/val (with CEOS WGCV)
- Advocate for benchmark systems
- Quarterly reports of observing system performance and recommended solutions
- Improved sensor characterisation
- High quality radiances for NWP & Climate

Meeting Goals

- Assess progress and efforts needed to reach our 2008 targets
- Develop priority areas for 2009
  - Begin to focus on prelaunch requirements
  - Advocate aircraft campaigns for absolute calibration with SI traceability
  - Tie GSICS results with development of CDRs

GSICS OPERATIONS PLAN 2007-2008

Task	PI	Significance	Deliverable	Completion Date	Mar-07	Jun-07	Sep-07	Dec-07	Mar-08	Jun-08	Sep-08	Dec-08
Internal meetings	**EXP**	**Governance**	**See below**	**Continuous**								
Executive Panel Meeting	EXP	Guide the GSICS program	Meeting report	2nd & 4th quarter		Δ		Δ		Δ		Δ
GRWG Meeting	All	Support the GSICS by resolving the related scientific issues	Meeting report	1st & 3rd quarter	Δ	Δ			Δ		Δ	
GDWG Meeting	All	Support the GSICS by resolving the related data management issues	Meeting report	Annually or semi-annually		Δ						
Communication	**EP**	**Inform all involved**	**See below**	**Continuous**								
GSICS Web Site	NESDIS	Provide information, reports, results and links to Members	GSICS web site	2007 Q1 +continuous	Δ							
Quarterly Newsletter	NESDIS	Inform members and stake-holders	Newsletter delivered electronically	Every Quarter	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Report to GCOS/AOPC	EXP Chair	Inform GCOS/AOPC and coordinate with their activities	Briefing and debriefing	2007 Q2		Δ						
Report to CEOS Cal/Val	EXPChair	Inform CalVal and coordinate with their acticvities	Briefing and debriefing	2007 Q3			Δ					
Report to CEOS plenary	WMO	Inform CEOS and coordinate (as part of WMO report)	Briefing and debriefing	2007 Q4				Δ				
Report to CGMS	WMO/ EXPChair	Inform CGMS and coordinate with their activities	Briefing and debriefing	Annually				Δ				Δ
Publicize GSICS at scientific meetings and in scientific publications	All	Inform satellite and user community about GSICS : Calcon, IGARSS, SPIE	Presentations and papers	Continuous			Δ Δ Δ					
LEO-LEO IR and MW Intercomparison	**NESDIS**	**Evaluate Satellite Instrument Calibration**	**Evaluation of Satellite Instrument Calibration**	**Continuous**								
LEO-LEO Operational implementation	NESDIS	Initiate regular provision of data for evaluation	Data for evaluation	2007 Q1		Δ						
LEO-LEO Analysis (excluding IASI)	NESDIS	Routinely evaluate measurement comparability (AMSU, SSM/I, HIRS, AVHRR, MODIS, AIRS)	Evaluation results	Continuous	Continue							
Start AIRS-IASI SNO acquisition	NESDIS	Initiate regular acquisition of IASI data granules for evaluation	SNO of AIRS-IASI	2007 Q3			Δ					
AIRS-IASI SNO Analysis	NESDIS	Initiate AIRS-IASI intercalibration evaluation	Evaluation of AIRS-IASI intercalibration	2007 Q4					Δ	Continue		

GSICS OPERATIONS PLAN 2007-2008

Task	PI	Significance	Deliverable	Completion Date	Mar-07	Jun-07	Sep-07	Dec-07	Mar-08	Jun-08	Sep-08	Dec-08
GEO-LEO Infrared Hyperspectral comparison	GCC (NESDIS)	Pilot project with AIRS to demonstrate the process and benefit of GSICS continued with IASI in operational phase	See below	Data collection Analysis				Δ		Δ	Continue	
Data acquisition for the focus Day (21 Febr. 2007)	GCC	Matchup data from AIRS and 6 GEO's, all IR bands, on selected day for the development of the preliminary algorithm	Focus day SNO dataset available to members in agreed format	2007 Q1	Δ							
Preliminary algorithm development and implementation	All GPRC	Implement algorithm with agreed colocation criteria, threshold values, spectral convolution method	Similar preliminary algorithm implemented at each GPRC	2007 Q3		Δ						
Algorithm off-line testing	All GPRC	Using the focus dataset to check algorithm implementation	Preliminary Algorithm	2007 Q2		Δ						
Routine AIRS data transmission to GPRC	GCC	Initiate routine transmission AIRS granules colocated with GEOs	Relevant AIRS granules available in NRT to each GPRC	2007 Q4				Δ				
Repeat data acquisition for Focus Day for GEO, AIRS/MODIS, with IASI/AVHRR	GCC	Matchup data from AIRS and IASI and 6 GEO's, all IR bands, on selected day	Collocated six GEO, AIRS/MODIS, and IASI/AVHRR for one day	2007 Q3			Δ					
Repeat Focus Day for GEO, AIRS/MODIS, with IASI/AVHRR - Analysis	All GPRC	Evaluate IASI calibration using matchup of 6 GEOs with AIRS,MODIS, and IASI,AVHRR for one day	Preliminary evaluation of IASI calibration	2007 Q3				Δ				
Routine IASI data transmission to GPRC	GCC	Initiate routine transmission IASI data co-located with 6 GEOs	Relevant IASI granules available in NRT to each GPRC	2007 Q4				Δ				
Pre-operational LEO-GEO algorithm demonstration and testing	All GPRC	At least 1-month demonstration in an operational environment, for algorithm evaluation and adjustment	Evaluation and final algorithm	2008 Q1					Δ			
Operational LEO-GEO intercomparison	All GPRC	Project goal	Final algorithm implemented and results available	2008 Q2						Δ	Continue	

GSICS OPERATIONS PLAN 2007-2008

Task	PI	Significance	Deliverable	Completion Date	Mar-07	Jun-07	Sep-07	Dec-07	Mar-08	Jun-08	Sep-08	Dec-08
GEO-LEO and LEO-LEO Visible channels comparison	CNES	Expand GEO-LEO activities to solar channels	Algorithm	Data collection Analysis					Δ	Δ	Continue	
GEO-LEO	CNES	Comparability for solar bands	Algorithm	2007 Q4				Δ				
Special Targets (Tropical forests and Desert)	CNES	Alternative methods for GEO-LEO and LEO-LEO	Algorithm	2008 Q1					Δ			
Operational Visible comparisons	All		Results	Continuous						Δ	Continue	
Further developments												
GEO-LEO spectral band instruments	CMA	Expand the GEO-LEO activities to more sensors	GEO-LEO inter-calibration algorithm for spectral band sensors	Data collection Analysis					Δ	Δ	Continue	
Evaluate NASA LaRC DCC results	CMA	Improve the operational calibration at CMA (FY-2C, FY-1D, FY-3)	Evaluation report	2007 Q4				Δ				
Implement processing for AVHRR, MODIS, FY-3	CMA	Expand the GEO-LEO approach to more sensors	GEO-LEO inter-calibration algorithm for spectral band sensors	2008 Q1					Δ			
Operational GEO-LEO spectral band comparison	CMA	Expand the GEO-LEO approach to more sensors	GEO-LEO spectral band results	2008 Q2						Δ	Continue	
LEO-LEO additional instruments	All	Expand the LEO-LEO activities to more sensors	LEO-LEO inter-calibration algorithm and results for more sensors	Data collection Analysis					Δ	Δ	Continue	
Expand to additional instruments	NESDIS	Expand intercalibration to e.g. FY-3, HY-1B, AMSU-B, MHS, AMSR/E, SSM/IS, UV instruments, TMI	LEO-LEO inter-calibration algorithm and results for more sensors							Δ		