Preliminary Comparison of Radiometric Calibration Performance among CrIS, AIRS and IASI using GSICS GEO-LEO Inter-calibration

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What is GSICS

- What is GSICS?
  - Global Space-based Inter-Calibration System
  - International collaborative effort initialized in 2005 by WMO and CGMS
  - Effort to produce consistent, well-calibrated data from operational weather and environmental satellites of the Global Observing System (GOS)
- What are the basic strategies of GSICS?
  - Improve on-orbit calibration by developing an integrated inter-calibration system
    - Initially for GEO-LEO Inter-satellite calibration
    - Being extended to LEO-LEO
    - Using external references as necessary
  - Best practices for prelaunch characterisation (with CEOS WGCV)
- This will allow us to:
  - Improve consistency between instruments
  - Reduce bias in Level 1 and 2 products
  - Provide traceability of measurements
  - Retrospectively re-calibrate archive data
  - Better specify future instruments

GSICS Global Space-based Inter-Calibration System

EUMETSAT, CNES, JMA, NOAA, CMA, KMA, ISRO, NASA, WMO, USGS, NIST, JAXA, ROSHYDROMET, IMD, ESA

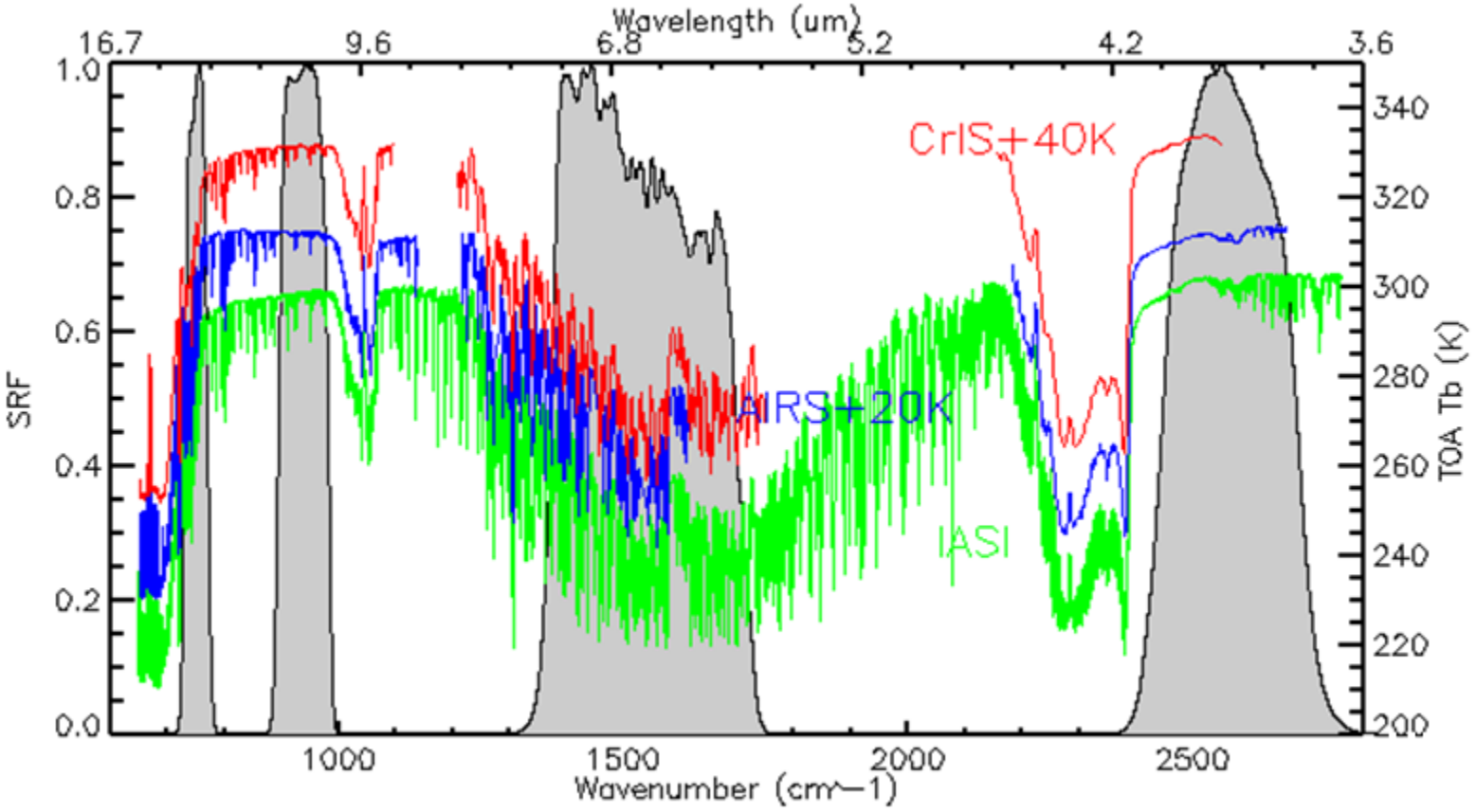
Courtesy of Tim Hewison

Objective

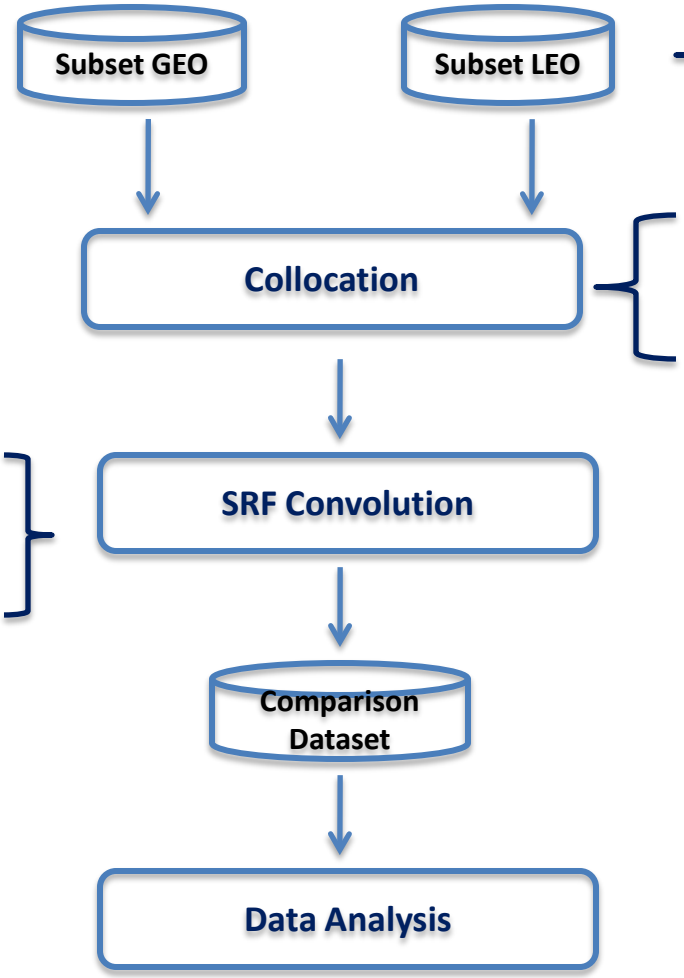
- GSICS was initiated with the GEO-LEO Infrared (IR) Inter-calibration in 2007
  - Reference to AIRS/IASI... CrIS
  - Algorithm is mature

- Objective: to evaluate the radiometric calibration performance among AIRS, CrIS and IASI, using the GSICS GEO-LEO collocation data
  - GOES Imager IR measurements as transfers
  - This method requires large amount of collocation data

GOES-13 Imager IR SRF & Simulated AIRS/CrIS/IASI TOA Tb over Clear Tropic Ocean



GSICS GEO-LEO Collocation Criteria



AIRS

CrIS

IASI

Collocation Criteria:

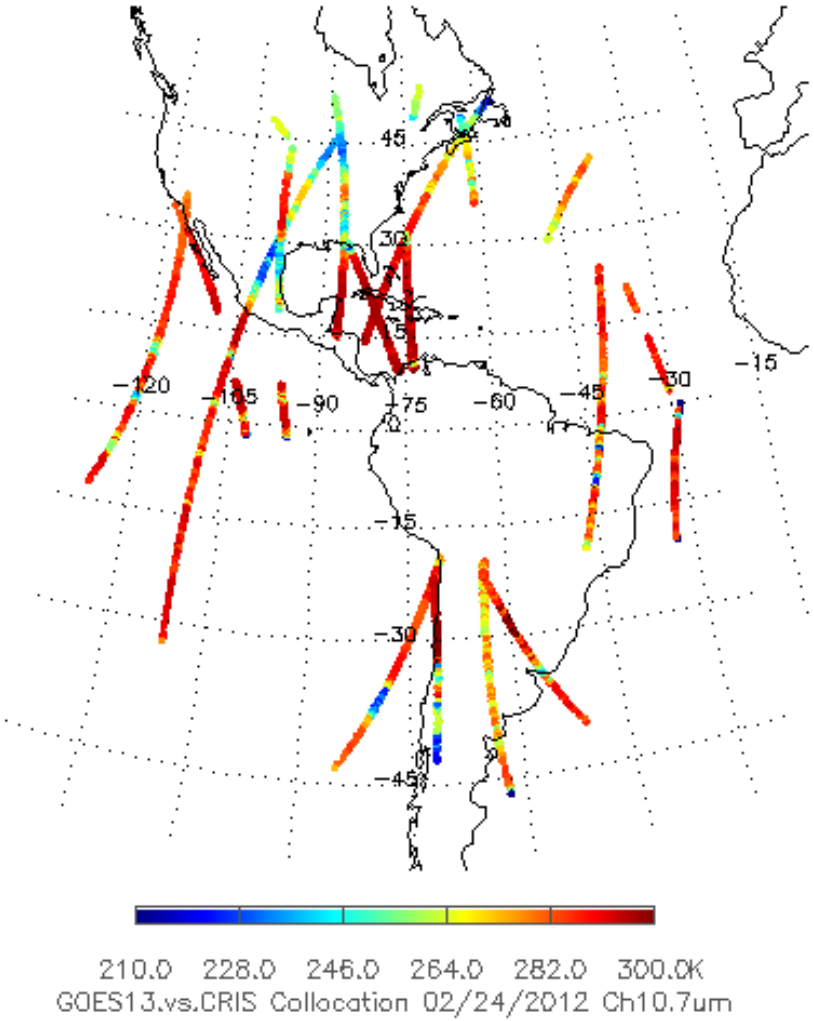
- closest pixel center < 4km
- time difference: < 5 minutes
- viewing zenith angle difference:

$$\left|\frac{\cos(geo\_zen)}{\cos(leo\_zen)}-1\right|<1\%$$

$$R_{GEO}=\frac{\int_{\nu}R_{\nu}\Phi_{\nu}d\nu}{\int_{\nu}\Phi_{\nu}d\nu}$$

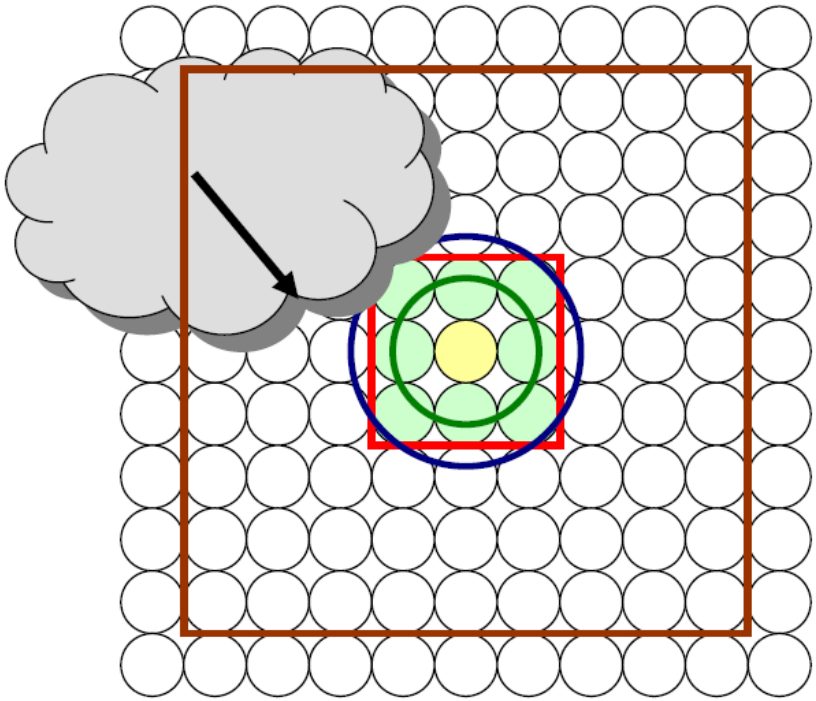
JMA's gap filling method used to fill the missing **AIRS** spectra

GOES-13 vs. CrIS Collocation Scenes on 2/24/2012



1. **Large temporal range**: Collocations range across multiple LEO orbits, ~4-5 hours for daily ascending/descending orbits.
2. **Large Tb range**: Scene Tb range from extremely cold (~210K at Ch10.7um) to very hot (~300K)

Homogeneous Scenes

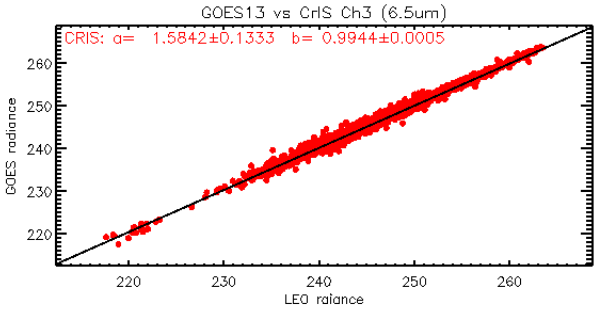


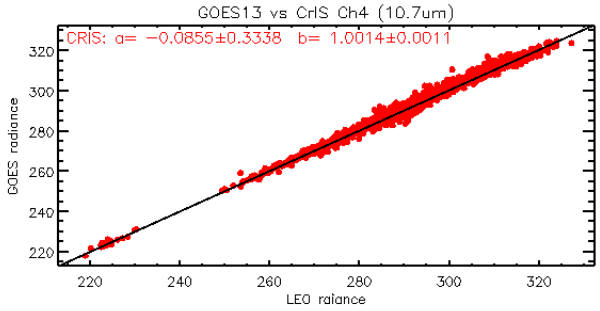
Target area:
STDV(GEO_Rad)/Mean(GEO_Rad) < 0.05

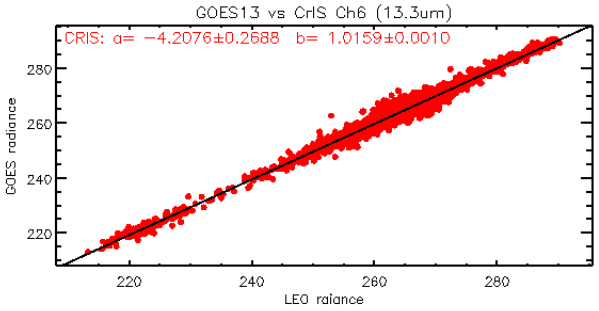
Environment area:
STDV(GEO_Rad)/Mean(GEO_Rad) < 0.05

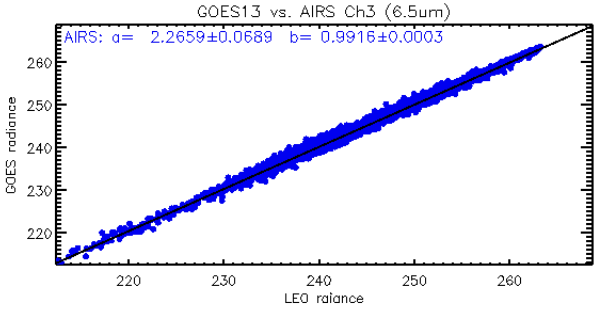
Wu et al. SPIE 2009

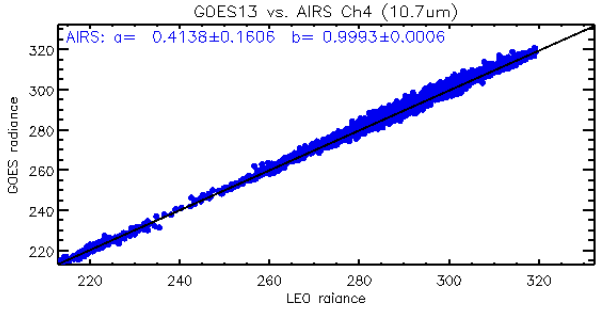
Scatter-plot of the Day-time Collocated Homogeneous Scenes

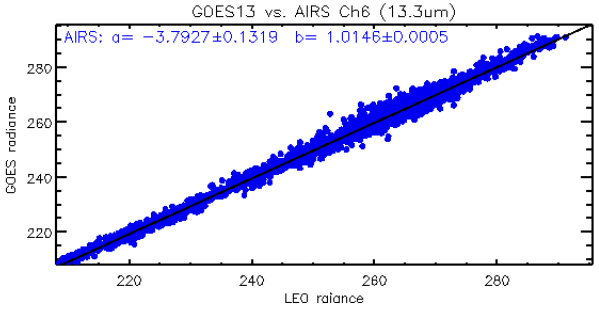


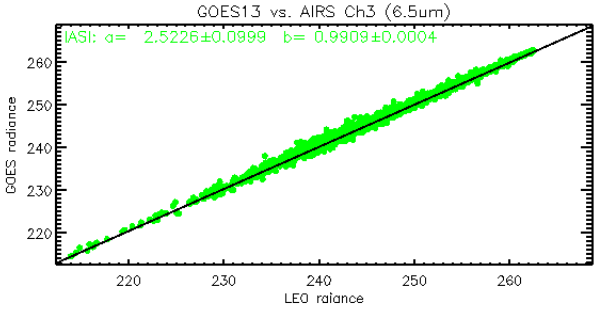


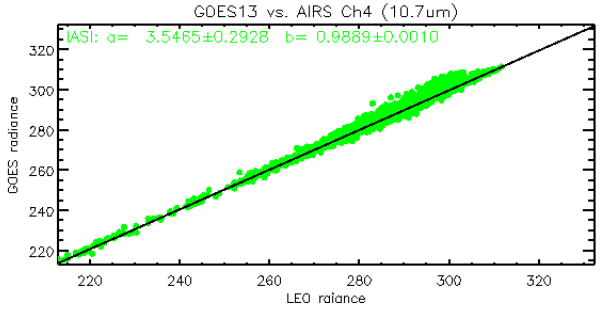


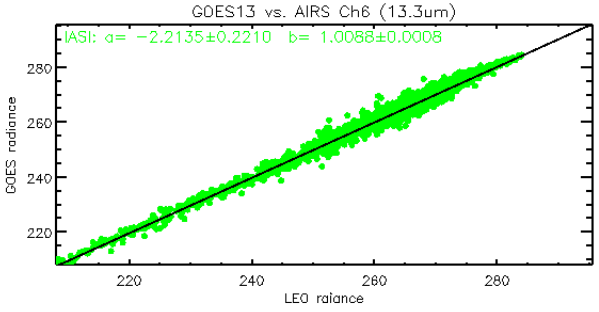




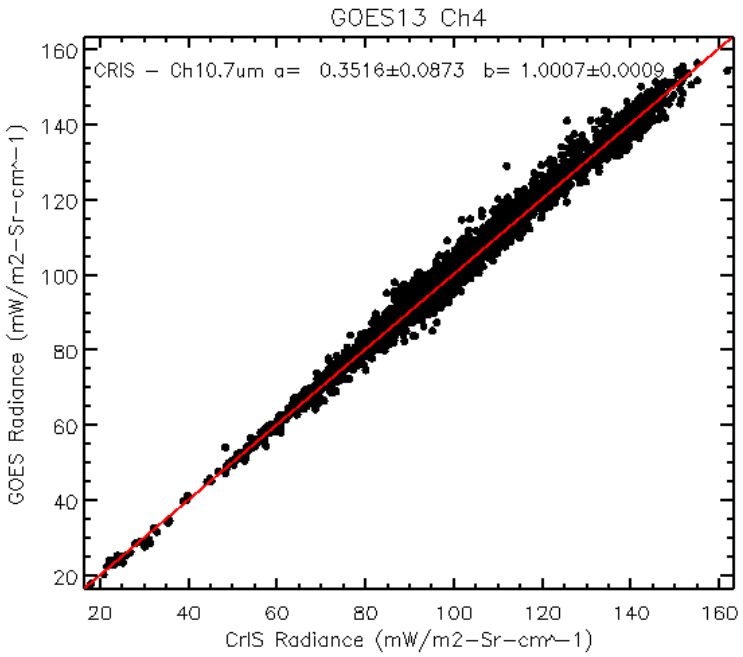


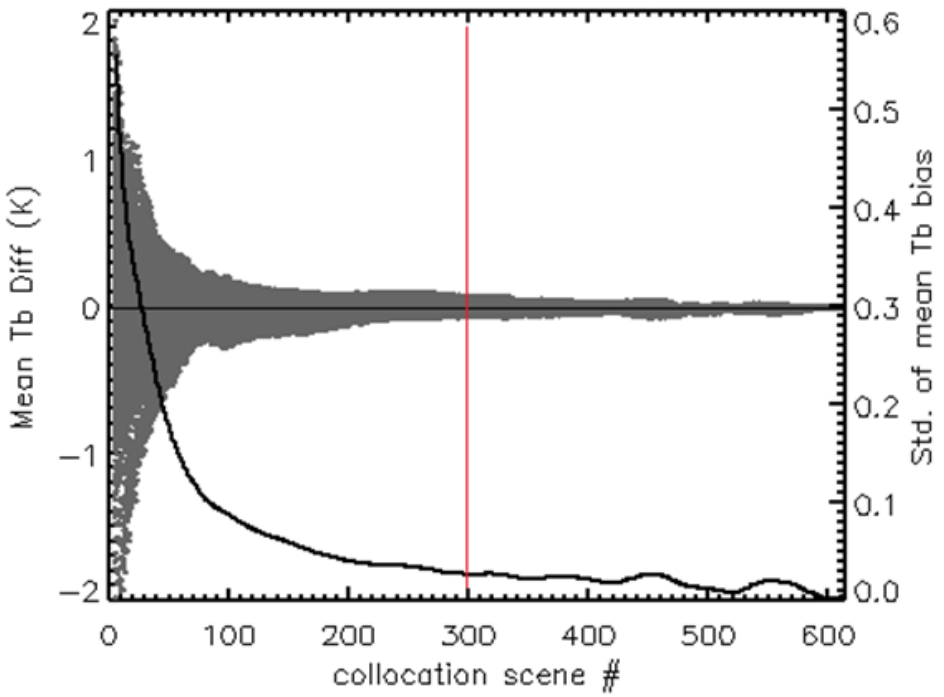






Using mean Tb bias to characterize calibration difference





- Homogeneous scenes
- #collocation pixel > 300
- Tb bias is of Gaussian distribution

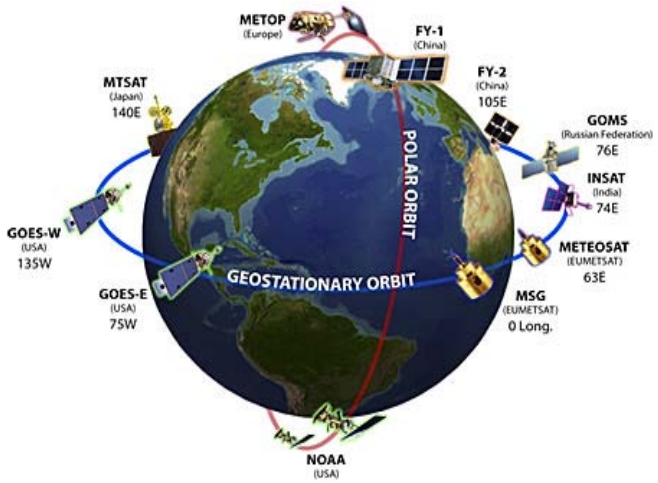
	Ch6.5um	Ch10.7um	Ch13.3um
Typical scene	245K	284K	267K

Double difference

Using GOES measurements as the transfer:

$$LEO_{A,t1} - LEO_{B,t2} = (LEO_{A,t1} - GEO_{t1}) - (LEO_{B,t2} - GEO_{t2}) - (GEO_{t2} - GEO_{t1}) + \varepsilon$$

A and B are two LEO instruments with equatorial crossing times at t1 and t2, respectively.
GEO_{t1} and GEO_{t2} are the GOES measurements at t1 and t2 time.
ε is the uncertainty of GEO-LEO inter-calibration algorithm

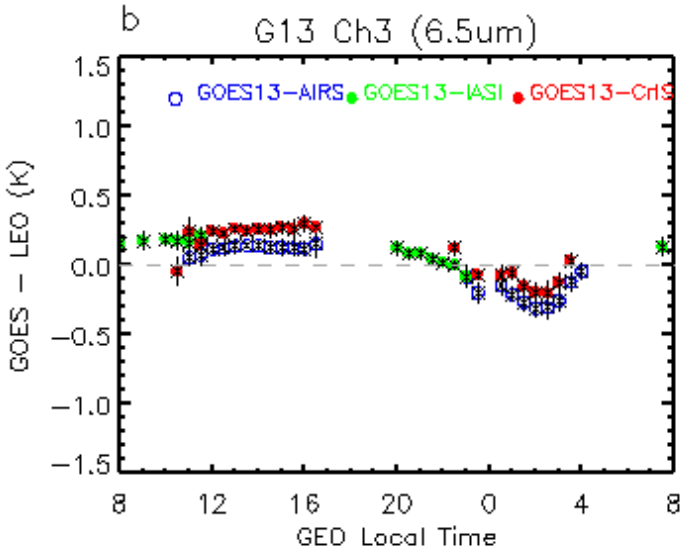


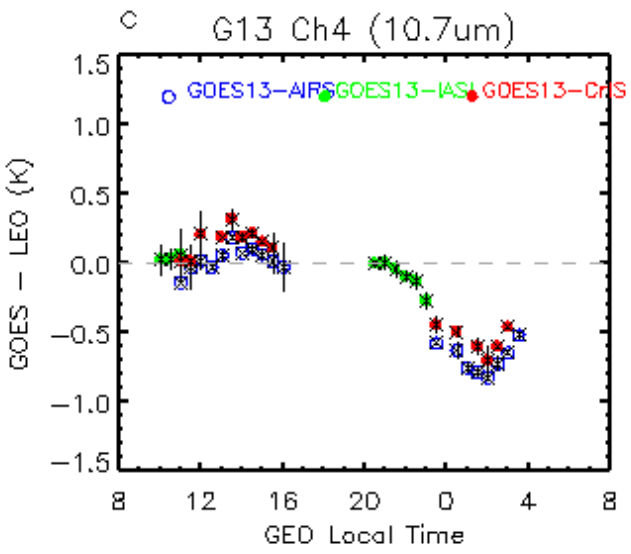
Instrument/ Satellite	LECT– ascending node	LECT – descending node
AIRS/Aqua	1:30pm	1:30am
CrIS/Soumi-NPP	1:30pm	1:30am
IASI/Metop-A	9:30pm	9:30am

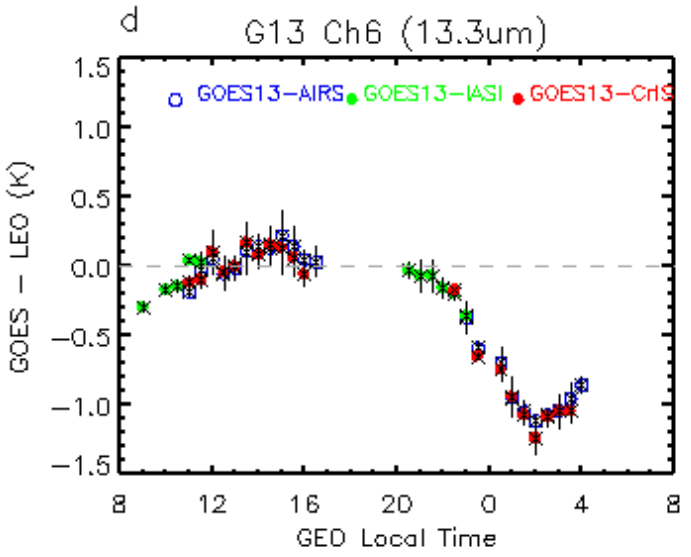
Wang et al. JGR 2011

Diurnal Variation – 1

Data: 04/18/2012 – 05/28/2012

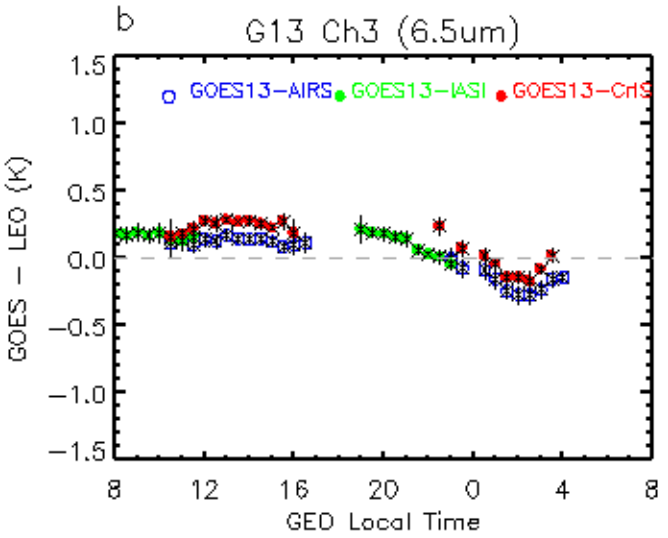


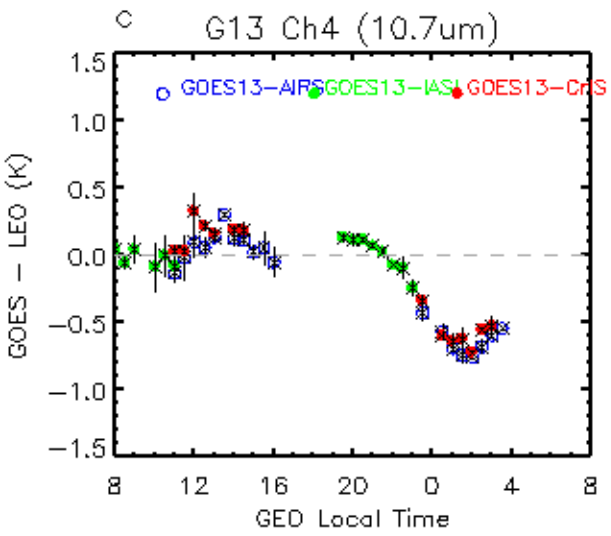


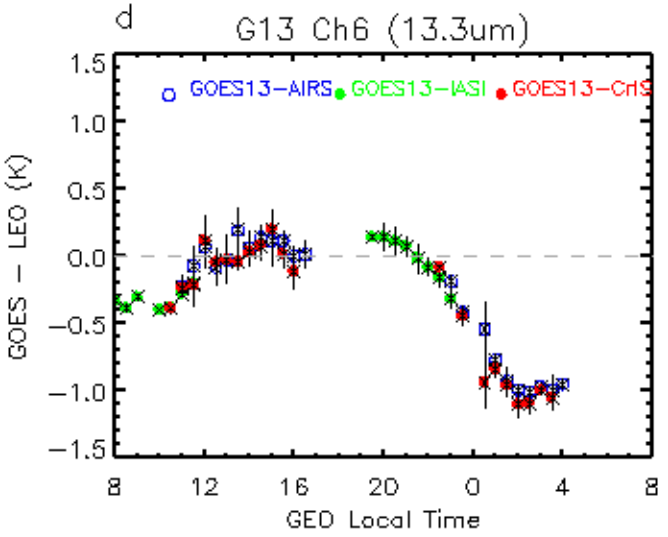


Diurnal Variation – 2

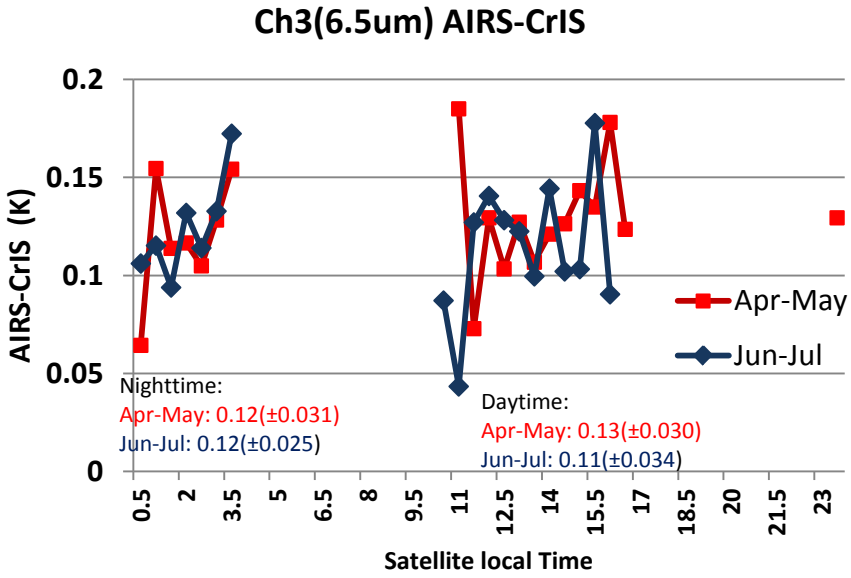
Data: 06/2/2012 – 07/12/2012

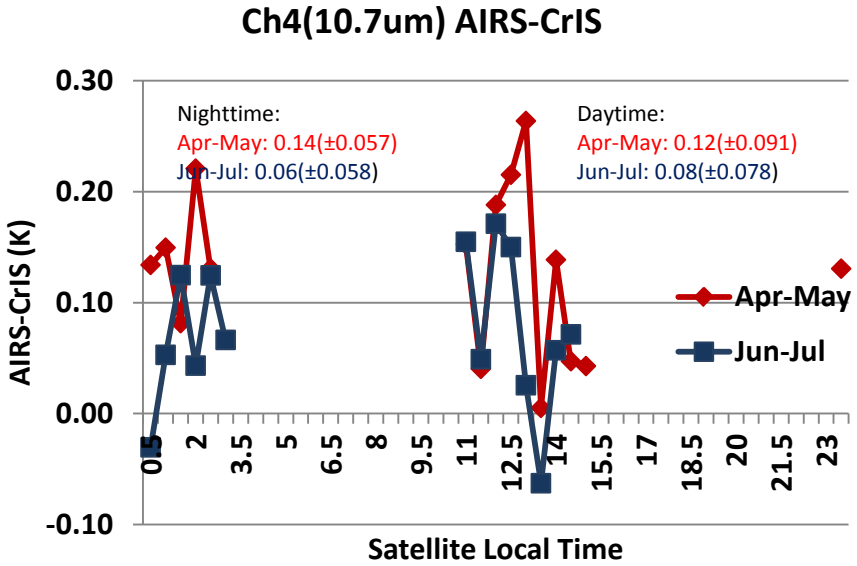


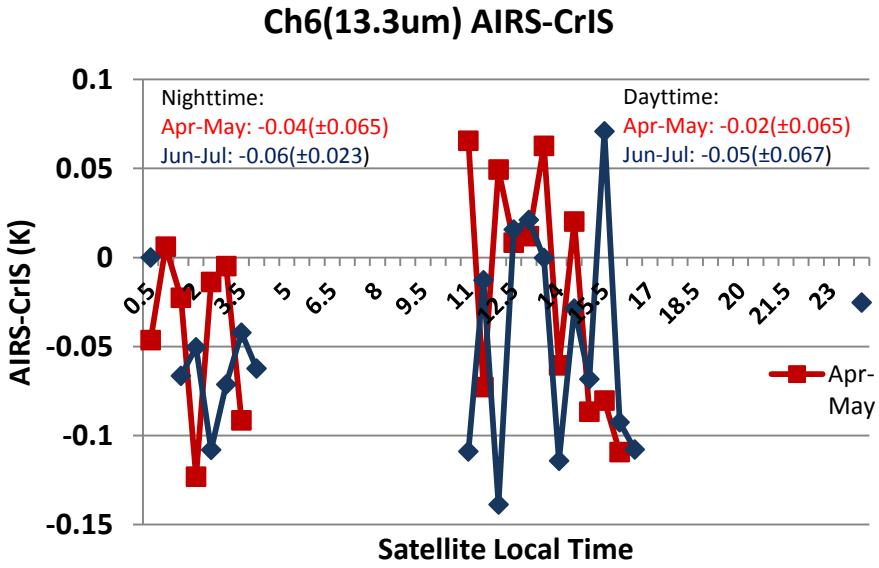




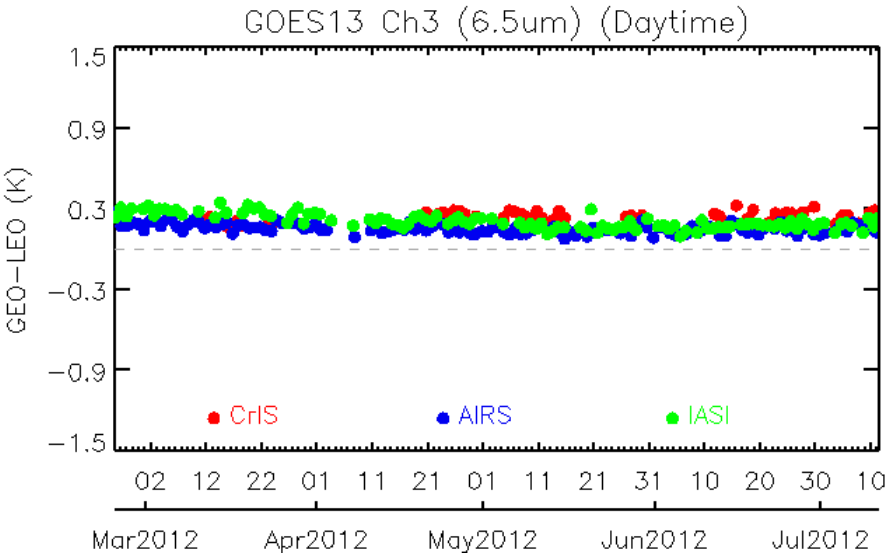
ARIS-CrIS (diurnal variation)

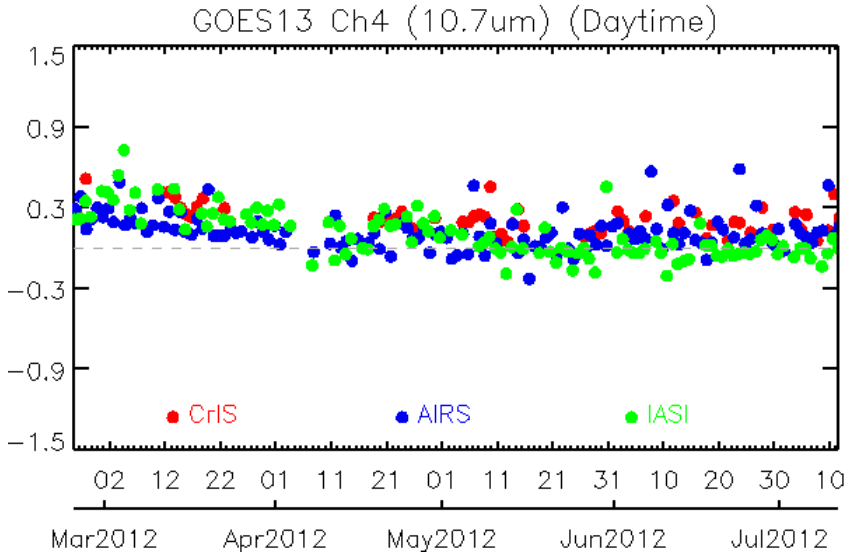


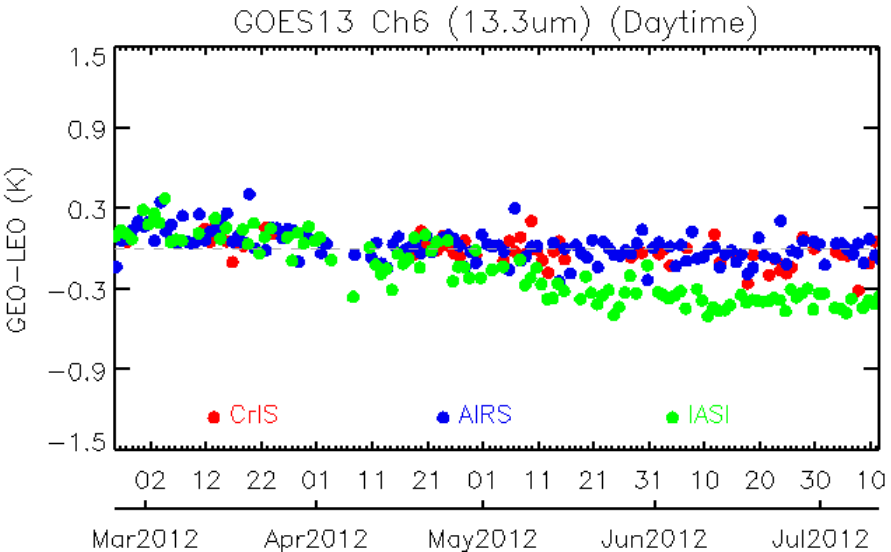




Time-Series of GEO-LEO Tb Difference







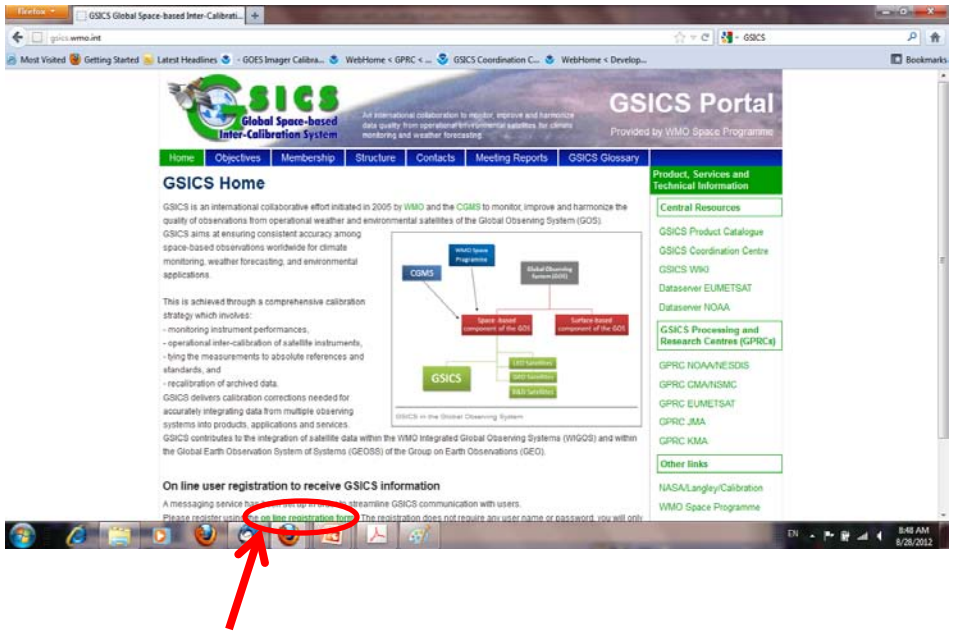
Summary

- Consistent diurnal Tb difference in between AIRS and CrIS
- The difference among AIRS/CrIS/IASI in general is less than 0.2K
- AIRS is slightly warmer than CrIS at ~0.2K at Ch6.5um
- AIRS is slightly warmer than CrIS at Ch10.3um, however, the Tb difference seems smaller at Jun-July than Apr-May at night-time data
- Among the three GOES IR channels, Tb difference between AIRS and CrIS is smallest at Ch13.3um
- CrIS overall radiometric calibration accuracy is very stable and comparable with AIRS/IASI during the study period

GSICS Users Messaging Service

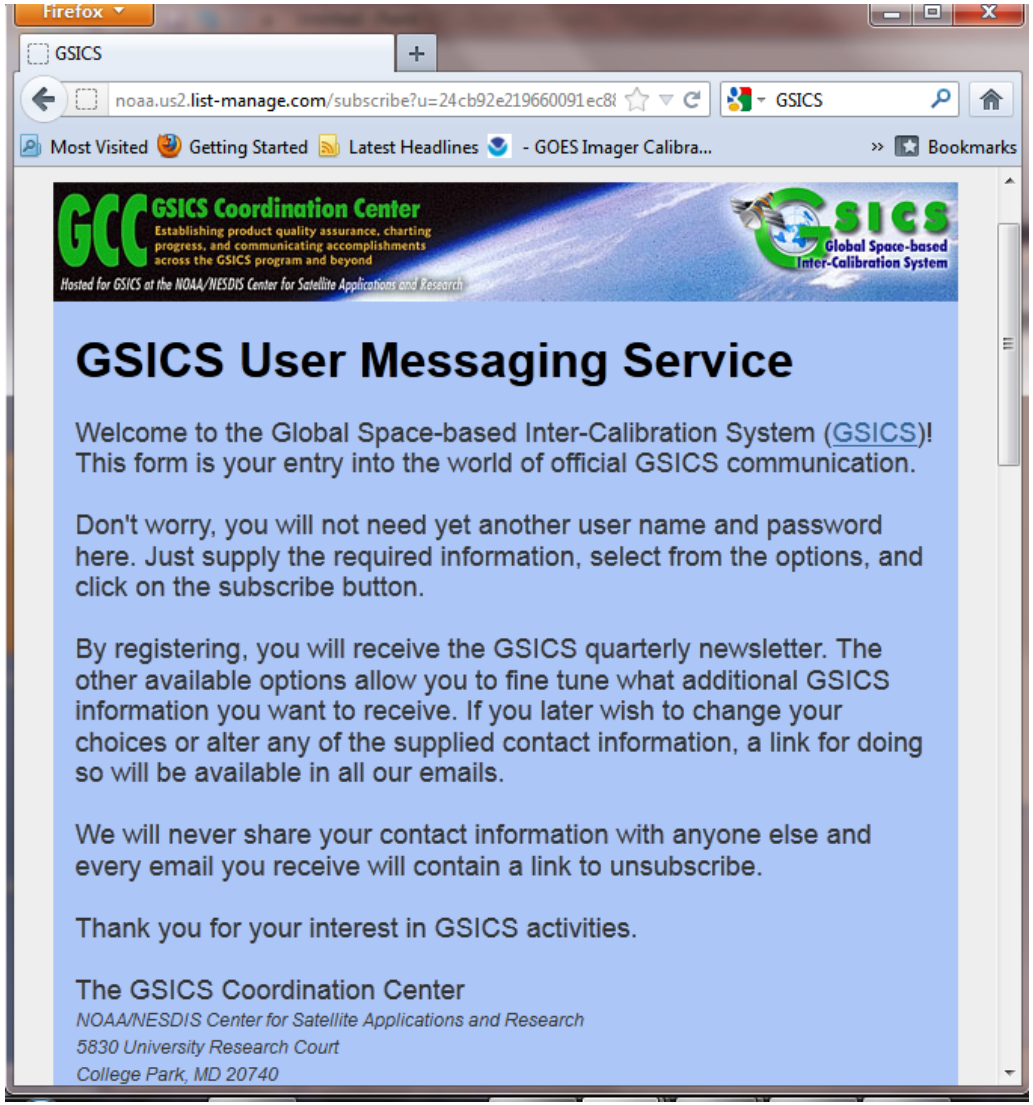
- Linked at WMO GSICS portal and GSCIS GCC website

http://gsics.wmo.int



http://www.star.nesdis.noaa.gov/smcd/GCC/index.php

GSICS Users Messaging Service



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