

IASI/MODIS IR Intercalibration

(aka: Promoting CLARREO as a very useful
asset for IR Intercalibration)

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**Space Science and Engineering Center,
University of Wisconsin-Madison**



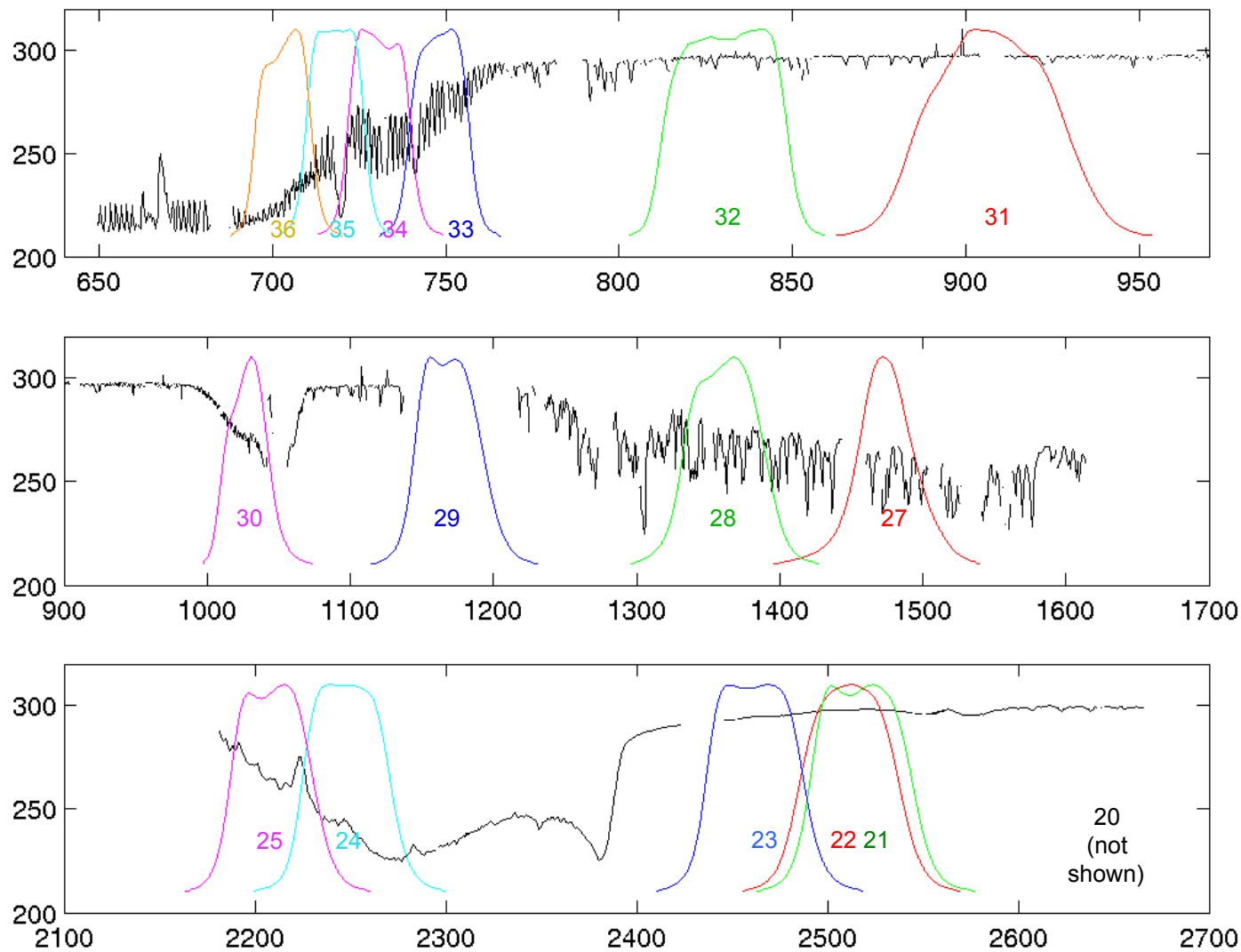
CLARREO Science Definition Team Meeting
Madison, WI
October 2011



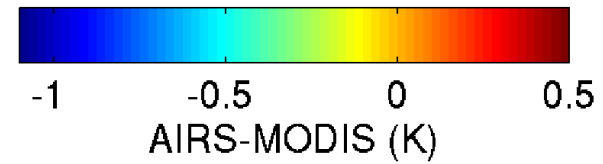
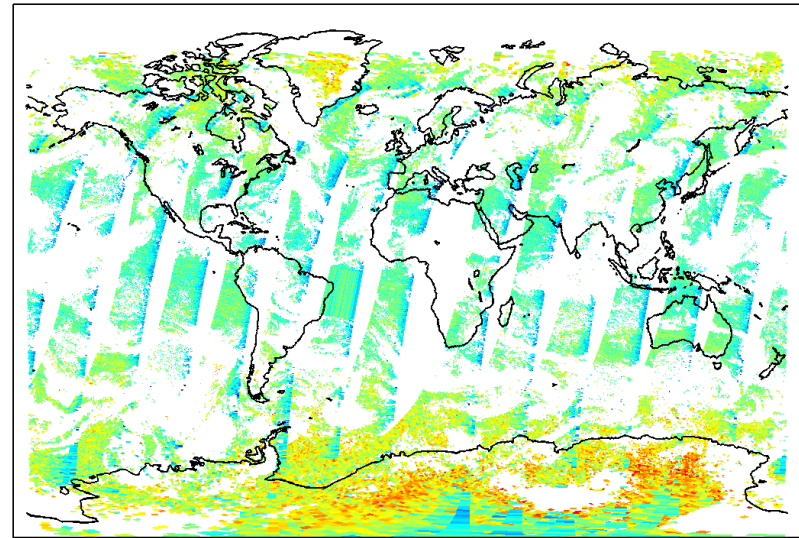
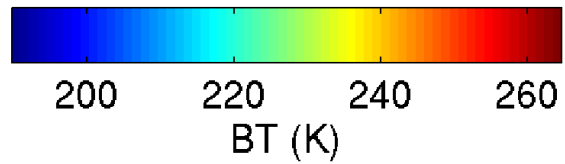
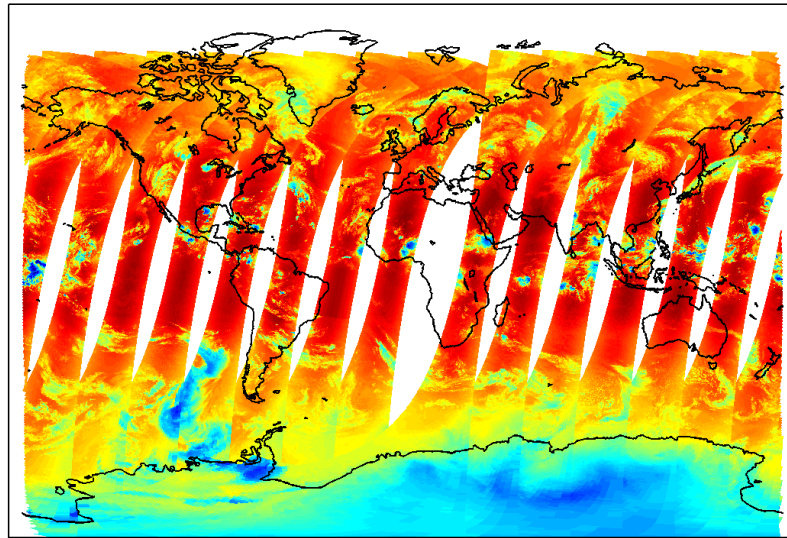
Outline

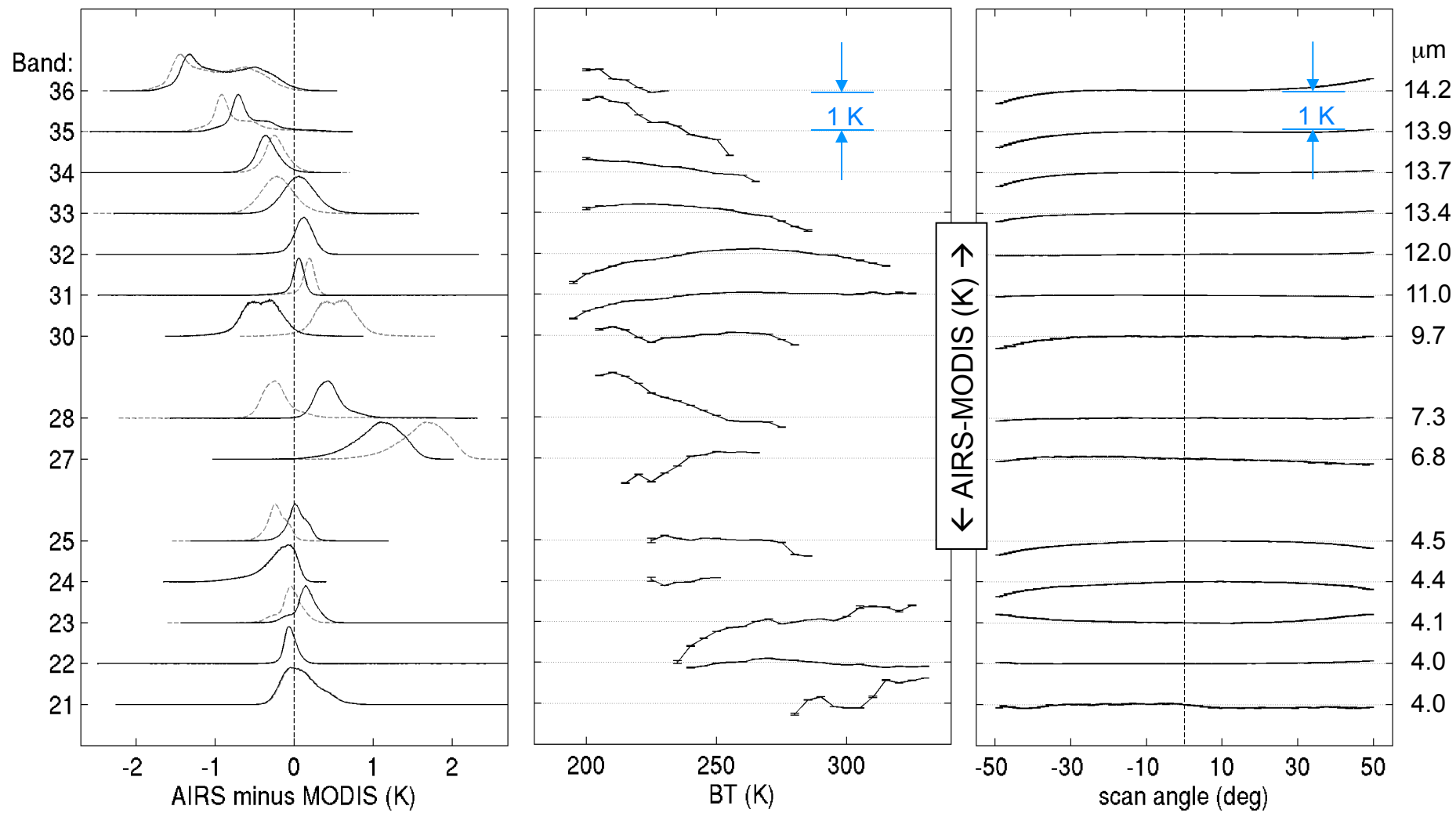
- 1. Summary of previous Aqua AIRS/MODIS Intercal results**
- 2. Example results of intercal on MODIS products**
 - MODIS Total Precipitable Water (TPW)
 - MODIS Sea Surface Temperature (SST)
 - MODIS Cloud top heights
 - HIRS thin cirrus trends
- 3. Aqua and Terra MODIS / IASI Intercal results**
- 4. CLARREO Intercal**

Summary of previous MODIS calibration findings based on Intercalibration with AIRS



Example comparisons for band 34 ($13.7\text{ }\mu\text{m}$) on 6 Sept 2002:

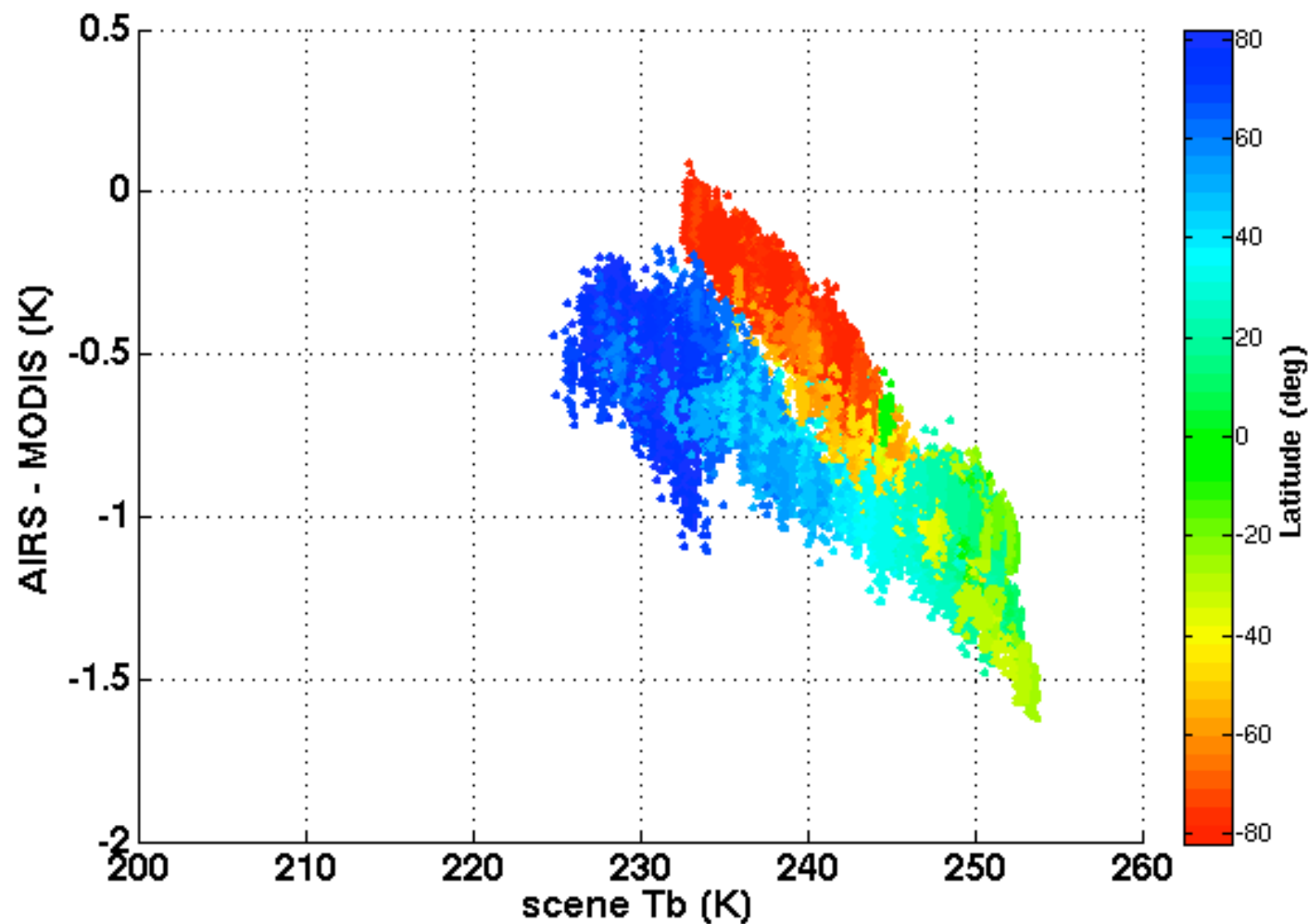




AIRS/MODIS radiance comparison example

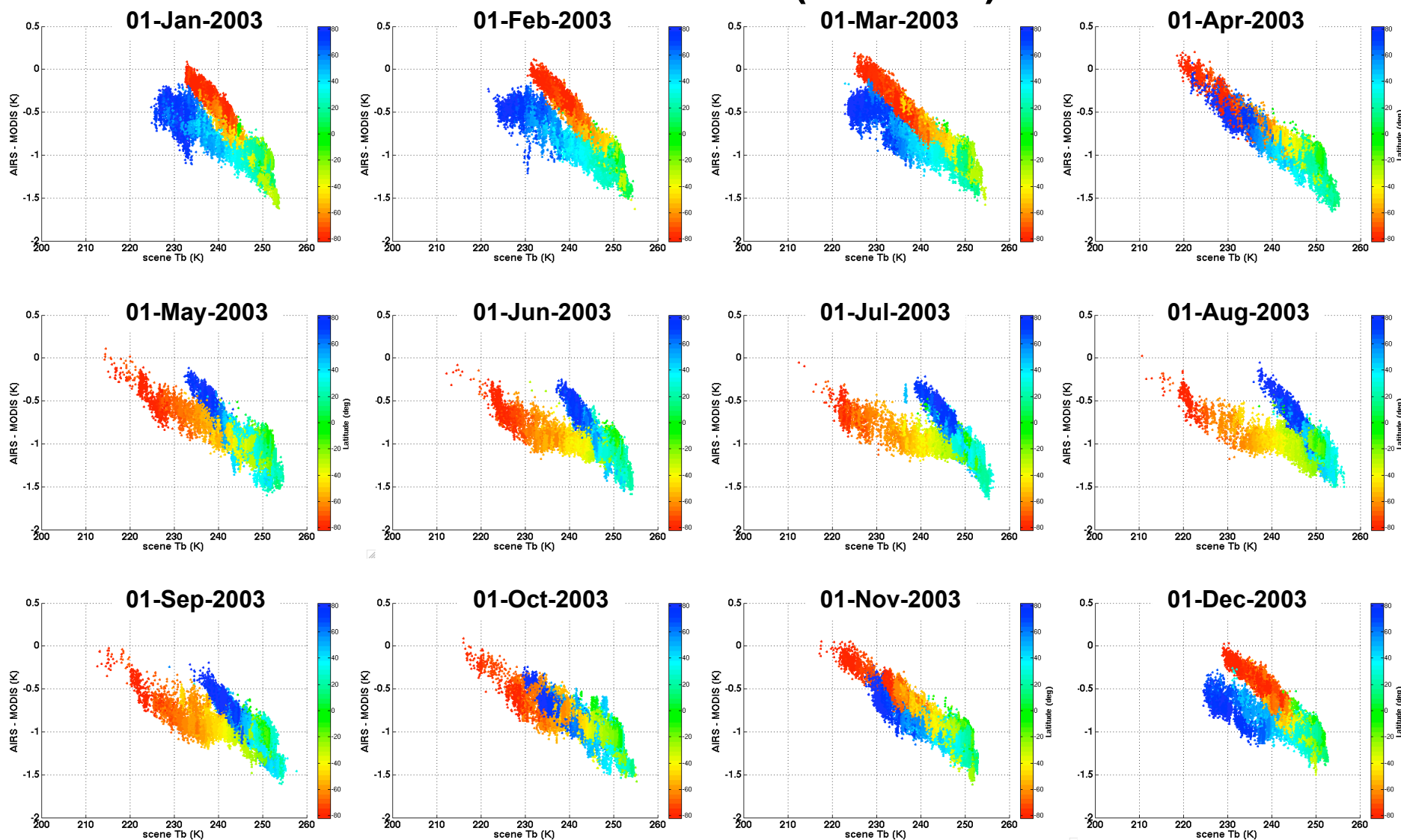
MODIS Band 35 ($13.9\text{ }\mu\text{m}$)

01-Jan-2003



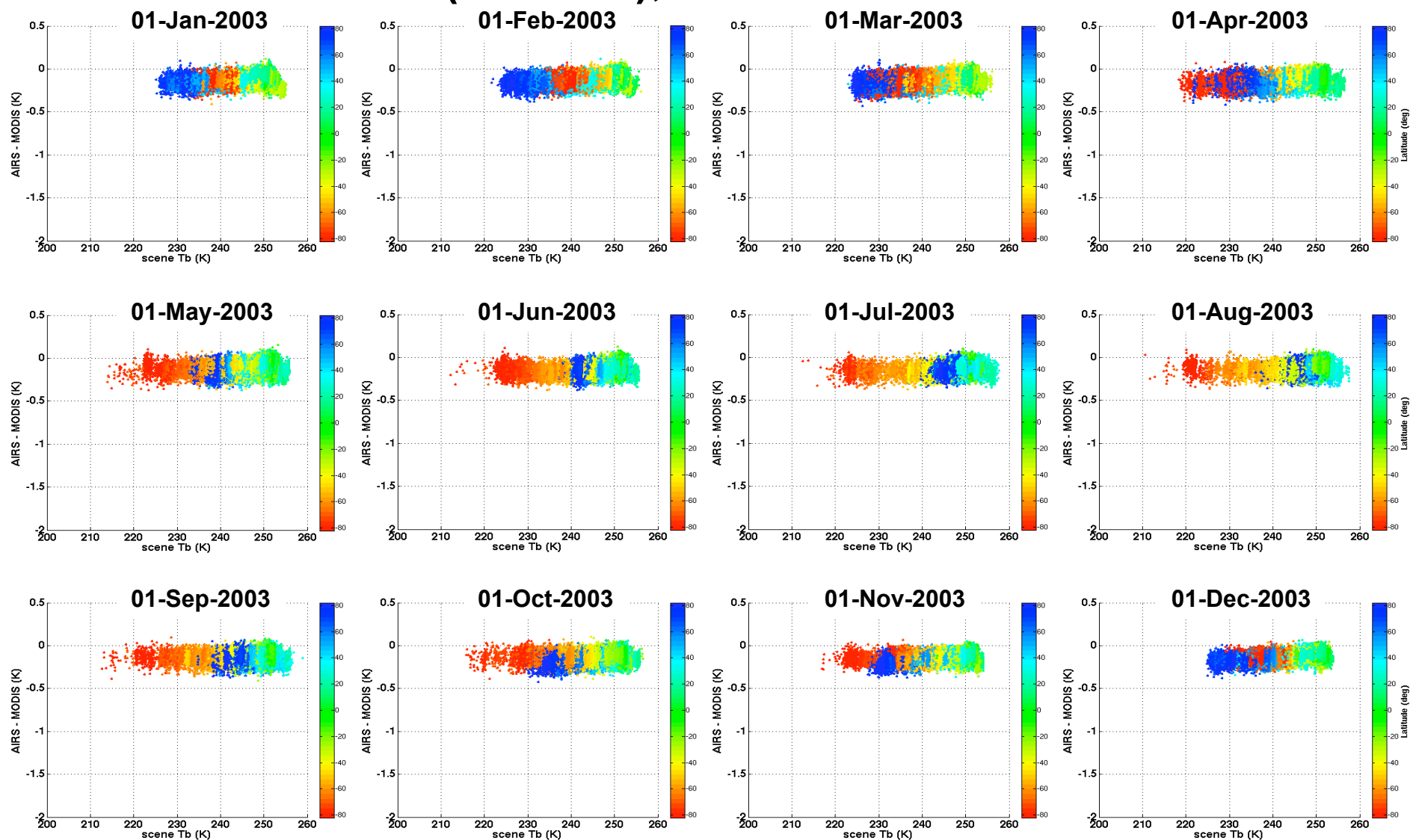
AIRS/MODIS radiance comparison example

MODIS Band 35 ($13.9\text{ }\mu\text{m}$)



AIRS/MODIS radiance comparison example

MODIS Band 35 (13.9 μm), with 0.8 cm^{-1} MODIS SRF shift



Why do Intercal?

**For a wide range of purposes,
from climate trending
to reanalysis
to process studies
to weather forecasting**

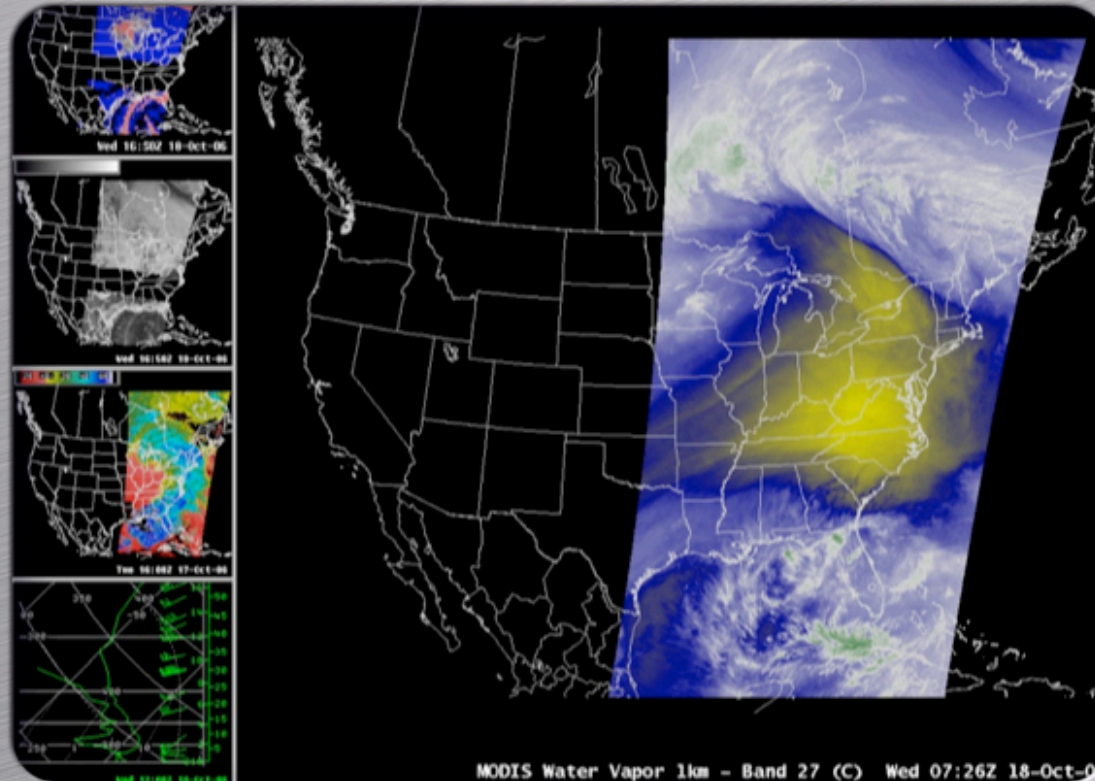
(i.e. lots of “customers”)

Example MODIS IR products

- Clear sky atmospheric T/q profiles
- Total Precipitable Water*
- Stability indices*
- Total Ozone
- Land and Sea Surface Temperature*
- Cloud Top Properties*
- Fire detection
- Fog detection

* particularly sensitive to calibration

MODIS Products in AWIPS

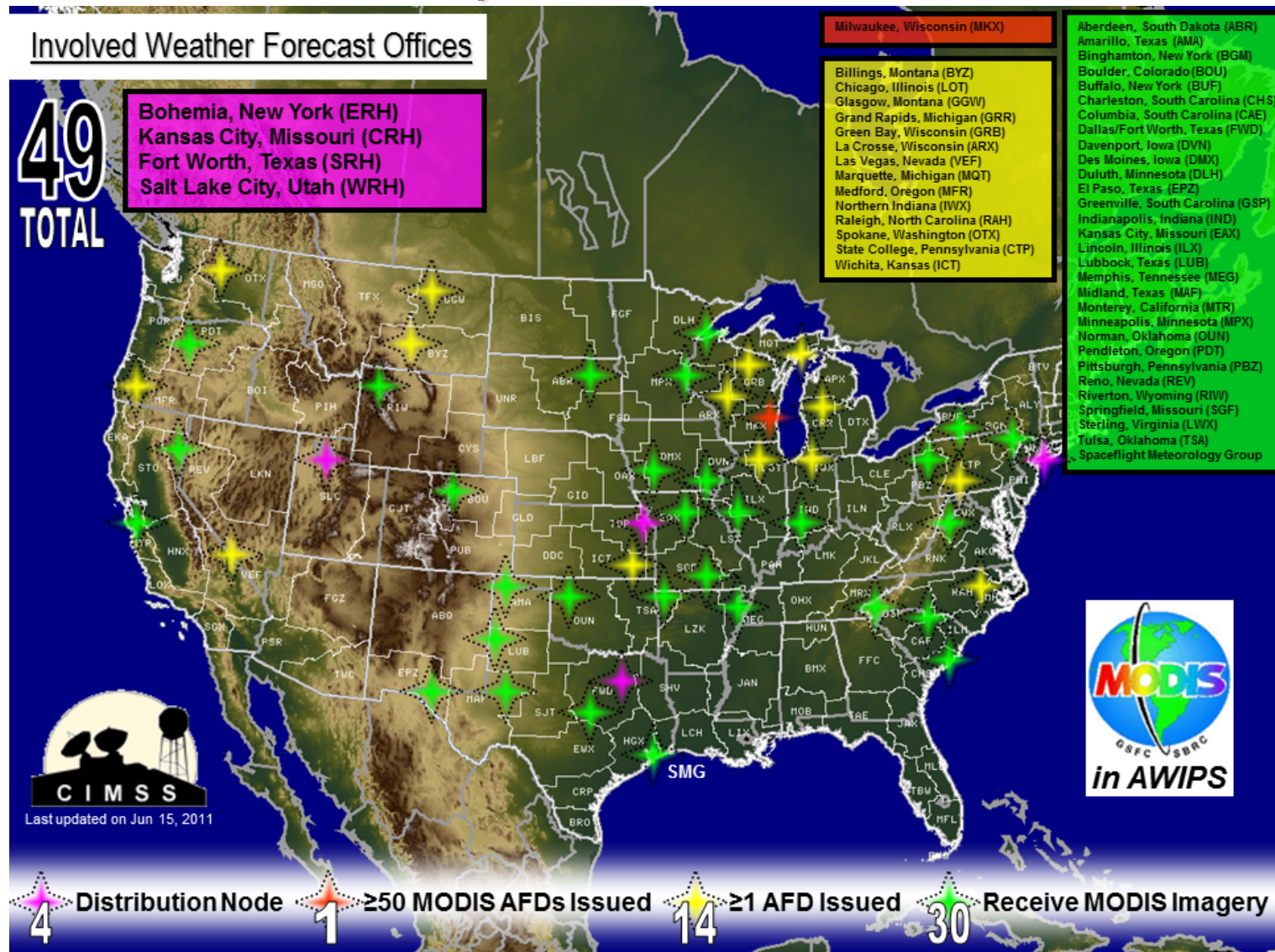


National Weather Service • Integrated Sensor Training Professional Development Series
Virtual Institute for Satellite Integration Training

Advanced Weather Interactive Processing System (AWIPS)

Strabala et al.

University of Wisconsin Direct Broadcast MODIS Data used by the National Weather Service



MODIS products now frequently used/mentioned in Area Forecast Discussions

MODIS Products in AWIPS

AREA FORECAST DISCUSSION NATIONAL WEATHER SERVICE

MILWAUKEE/SULLIVAN WI

422 AM CDT FRI AUG 3 2007

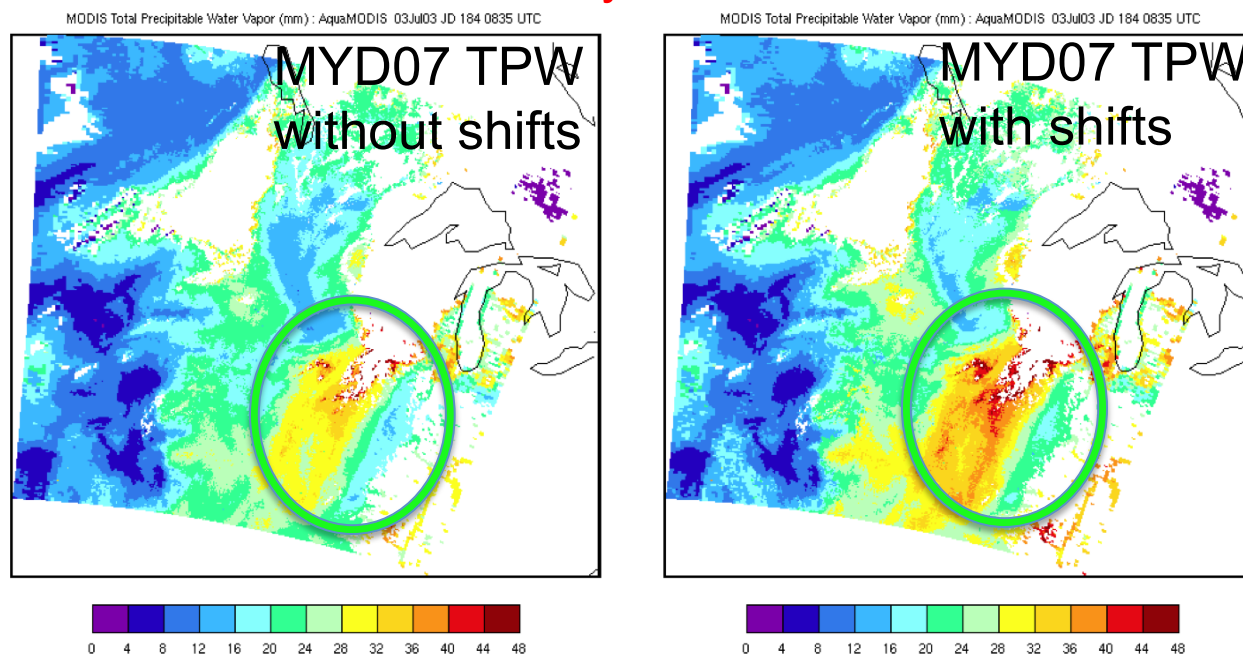
DISCUSSION...FORECAST FOCUS ON COOLER AND MUCH DRIER CONDITIONS TODAY...THEN PRECIPITATION CHANCES THIS WEEKEND THROUGH NEXT WEEK. 00Z 500/300MB ANALYSIS INDICATED A CLOSED UPPER LOW INVOF OF HUDSON BAY WITH A BROAD UPPER HIGH CENTERED NEAR THE 4-CORNERS AREA...VERY TYPICAL LOCATION FOR THIS TIME OF YEAR. PLACEMENT OF THESE FEATURES PRODUCING A DEEP...DRY NWLY FLOW OVER THE NRN PLAINS/GREAT LAKES REGION. AT THE SFC...WEAK TROF/COLD FRONT CONTINUES TO PUSH SOUTHEAST OF WI...ALLOWING SOME MUCH DRIER AIR TO FILTER INTO THE AREA. **IN FACT...04Z 4KM MODIS PW SOUNDER SHOWING PWS FALLING AOB 0.40" OVER MN/NRN WI CORRESPONDING WITH A BROAD AREA OF UPPER 40S-LOW 50S SFC DWPTS. 1KM MODIS LAKE SFC TEMP PRODUCT INDICATING NARROW RIBBON OF UPWELLING ALONG WRN SHORE OF LK MICHIGAN DUE TO OFFSHORE WINDS. IR IMAGERY EARLY THIS MORNING INDICATING CRYSTAL CLEAR SKIES OVER THE ENTIRE STATE OF WI.**

The impact of the Aqua H2O/CO2 channel spectral shifts on MYD07 TPW over the SGP Arm cart site

Comparison of total precipitable water (mm) at the ARM SGP site from Aqua MODIS with the ground-based ARM SGP microwave radiometer for 317 clear sky cases from 4/2001 to 8/2005.

MOD07 versions	SRF shift	DRY (TPW < 15mm) (228)		WET (TPW ≥ 15mm) (89)		ALL (317 cases)	
		Bias	RMS	Bias	RMS	Bias	RMS
Aqua Col 5.2	No	-0.4	2.2	3.6	5.1	0.8	3.3
Aqua Col 6	No	-0.2	2.3	4.6	5.7	1.1	3.6
Aqua Col 6	Yes	-0.8	2.5	2.3	3.8	0.1	3.0

TPW field at July 3, 2003 at 0800 UTC



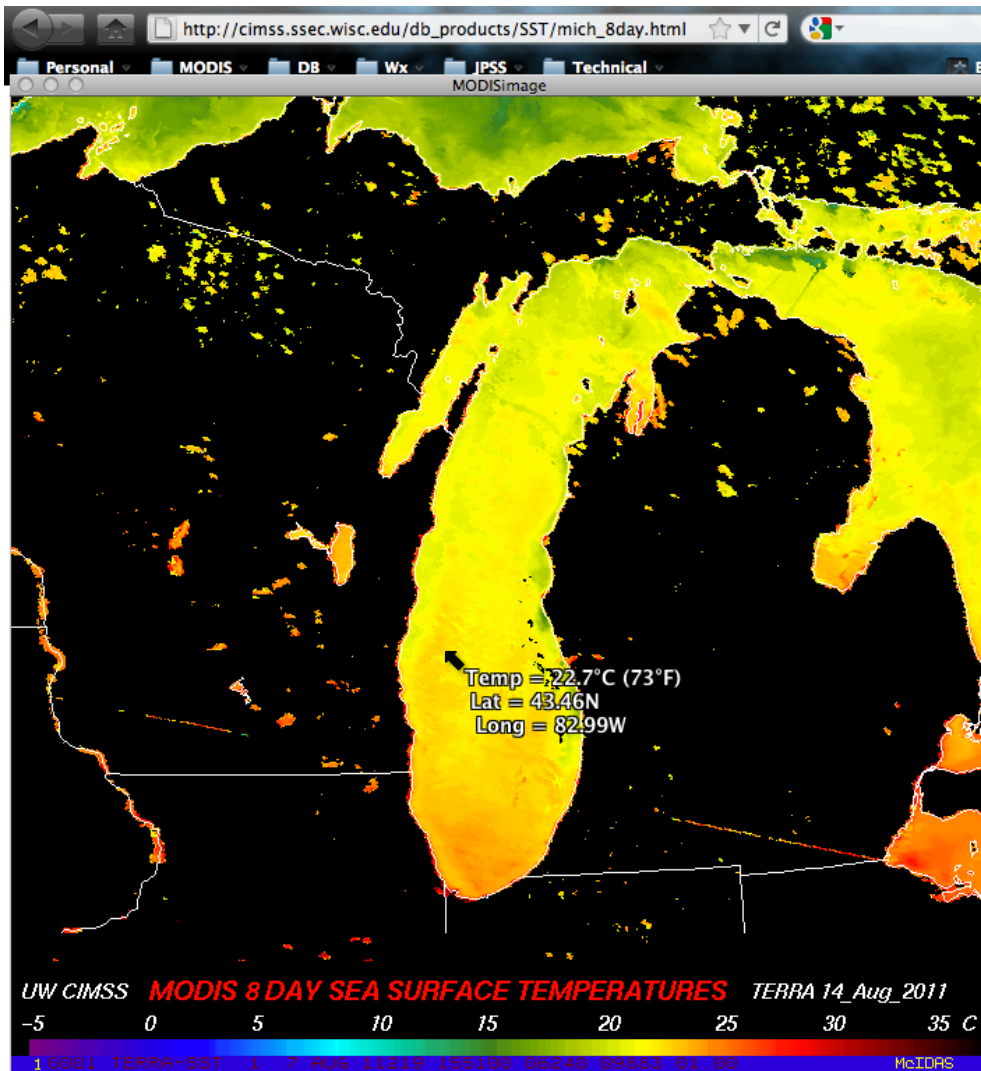
Borbas et al.

By applying the CO2/H2O spectral shifts, more moisture were introduced to the atmosphere => the MOD07 TPW dry bias at wet cases was significantly reduced over the SGP Cart site.

Support for Lake Effect Precipitation Forecast



Using Interactive MODIS 8 day Sea Surface Temperature Composites



AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE MILWAUKEE/SULLIVAN WI
324 PM CDT FRI AUG 12 2011

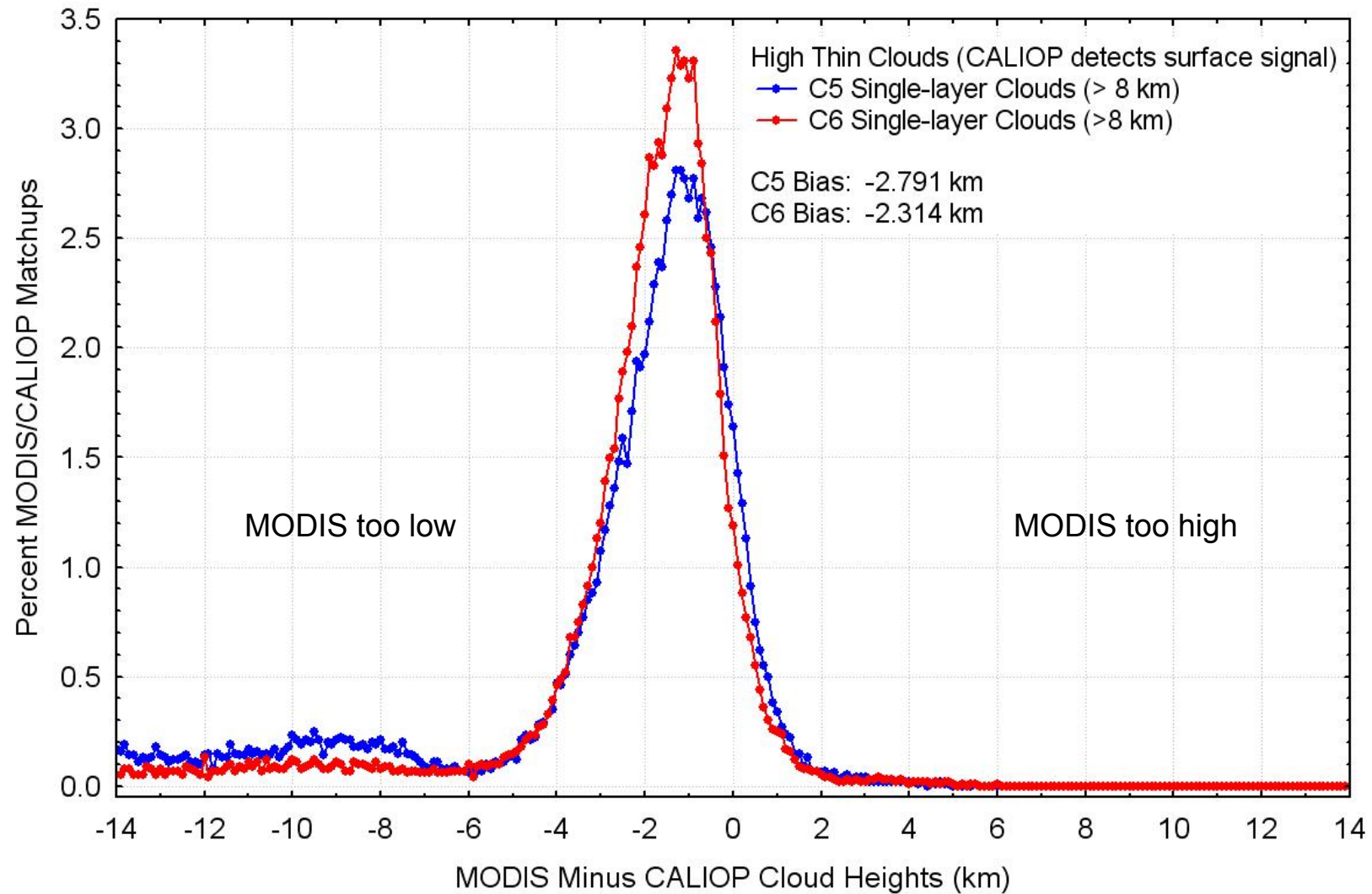
.SATURDAY NIGHT AND SUNDAY...FORECAST CONFIDENCE IS MEDIUM.

THIS PERIOD FEATURES THE FIRST OF MANY SALVOS ACROSS OUR BOW SUGGESTING THAT THE TRANSITION SEASON IS FAST APPROACHING. THE SFC LOW HAS EXITED TO THE EAST BY THIS TIME WITH THE MAIN UPPER LEVEL TROF FOLLOWING IN SHORT ORDER. HOWEVER...THE UPPER FLOW REMAINS DOMINANTLY CYCLONIC WITH SOME SECONDARY SPOKES ROLLING THROUGH LATER SATURDAY NIGHT AND SUNDAY MORNING. **THE COLD ADVECTION IN THE WAKE OF THE SFC LOW IS ENOUGH TO GET DELTA T/S OVER THE LAKE LARGE ENOUGH FOR LAKE EFFECT SHOWERS LATER SATURDAY NIGHT AND SUNDAY MORNING. THE COOPERATIVE INSTITUTE FOR MESOSCALE METEOROLOGICAL STUDIES /CIMSS/ MODIS 8 DAY SEA SURFACE TEMPERATURE ACROSS LAKE MICHIGAN SHOWS WATER TEMPERATURES NEAR OR AT THEIR SEASONAL PEAK OF 71 TO 73F. H8 TEMPS DROP TO ABOUT 12C...BRINGING A DELTA T OF 10.** NOT EXCESSIVE...BUT COUPLED WITH THE FORCING FROM THE CYCLONIC FLOW ALOFT AND ASSOCIATED LLV CONVERGENCE...IT LOOKS LIKE SOME LAKE EFFECT SHOWERS ARE A GOOD BET. THESE SHOULD DIMINISH BY SUNDAY AFTERNOON AS THE CONTRAST AND FORCING QUICKLY DIMINISH.

http://cimss.ssec.wisc.edu/db_products/SST/great_lakes/

Aqua MODIS Thin Cirrus Heights Collection 5 vs. Collection 6

August 2006, 60S-60N



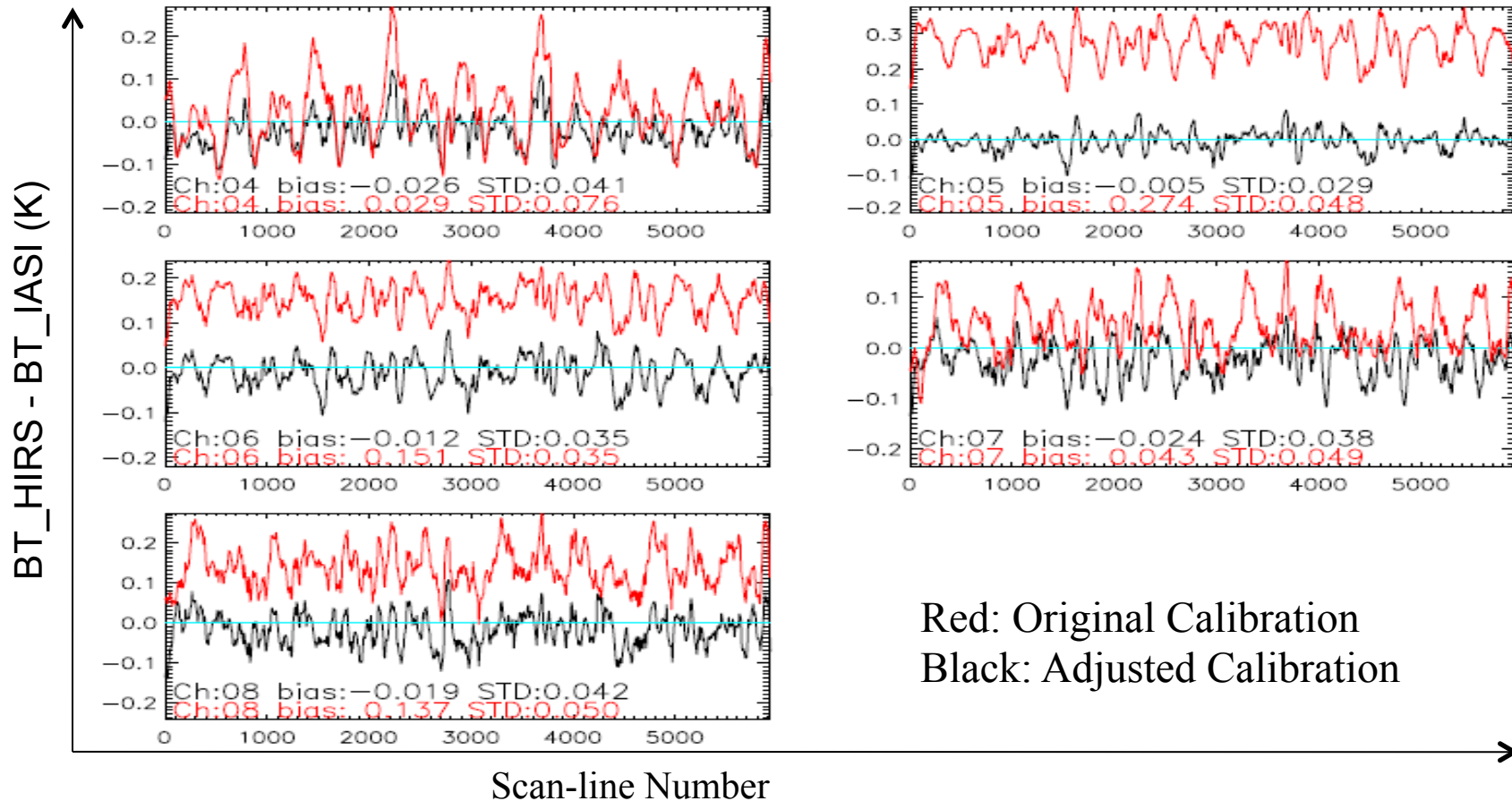
HIRS Recalibration

Recalibrate Metop-A HIRS using IASI

Then recalibrate all prior HIRS
using Simultaneous Nadir Overpasses

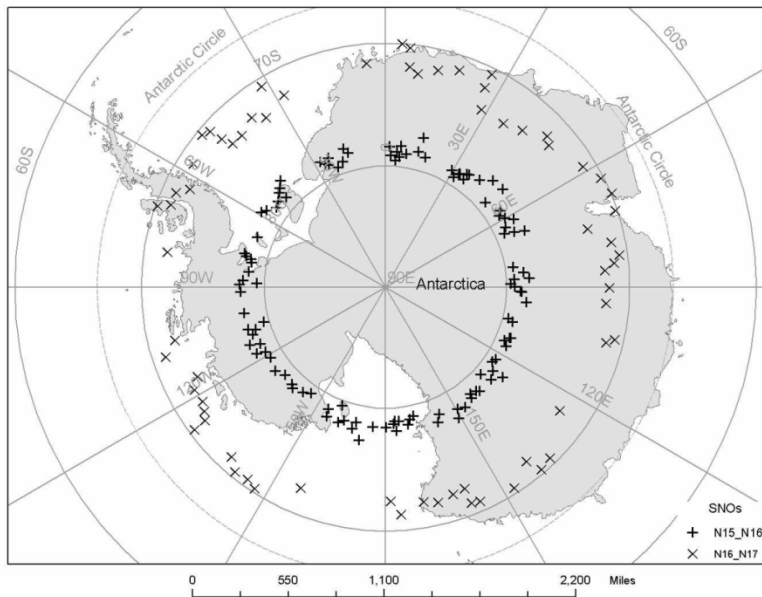
Menzel, Cao et al.

Validation of HIRS Calibration Adjustment using one day of MetOp data (05/23/09)

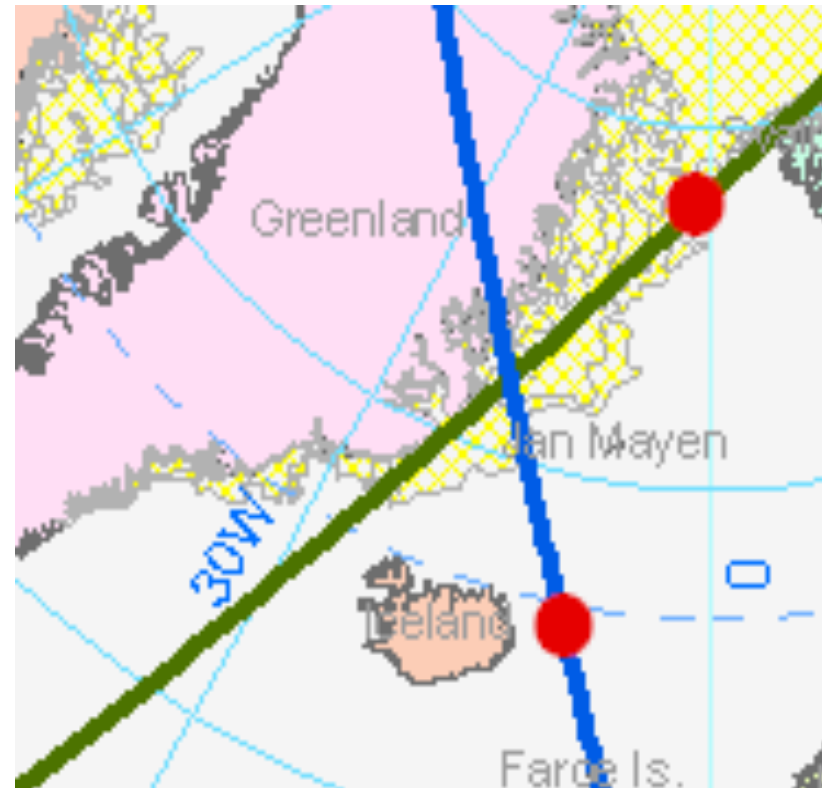


- Validated with one day (independent, different season) HIRS/IASI data from MetOp
- Both mean bias and bias variation are significantly reduced
- Other factors: inhomogeneity, instrument on-orbit variation, IASI uncertainties, non-unity of BB emissivity, and space-view biases ...

Toward an Integrated System for Intersatellite Calibration of POES using the SNO Method

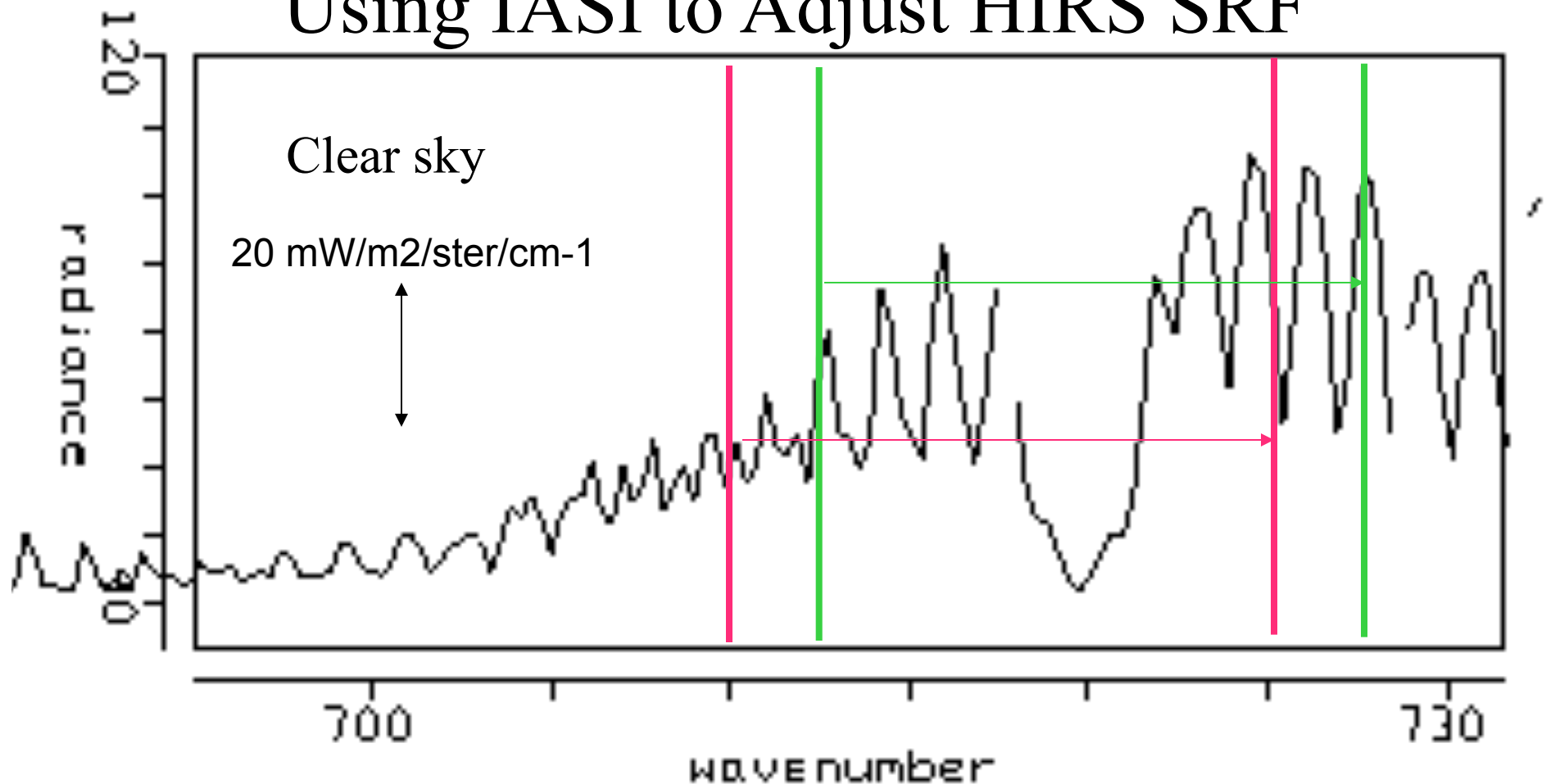


N15 & N16 (+) and
N16 & N17 (X)
SNO locations
from 2000 to 2003

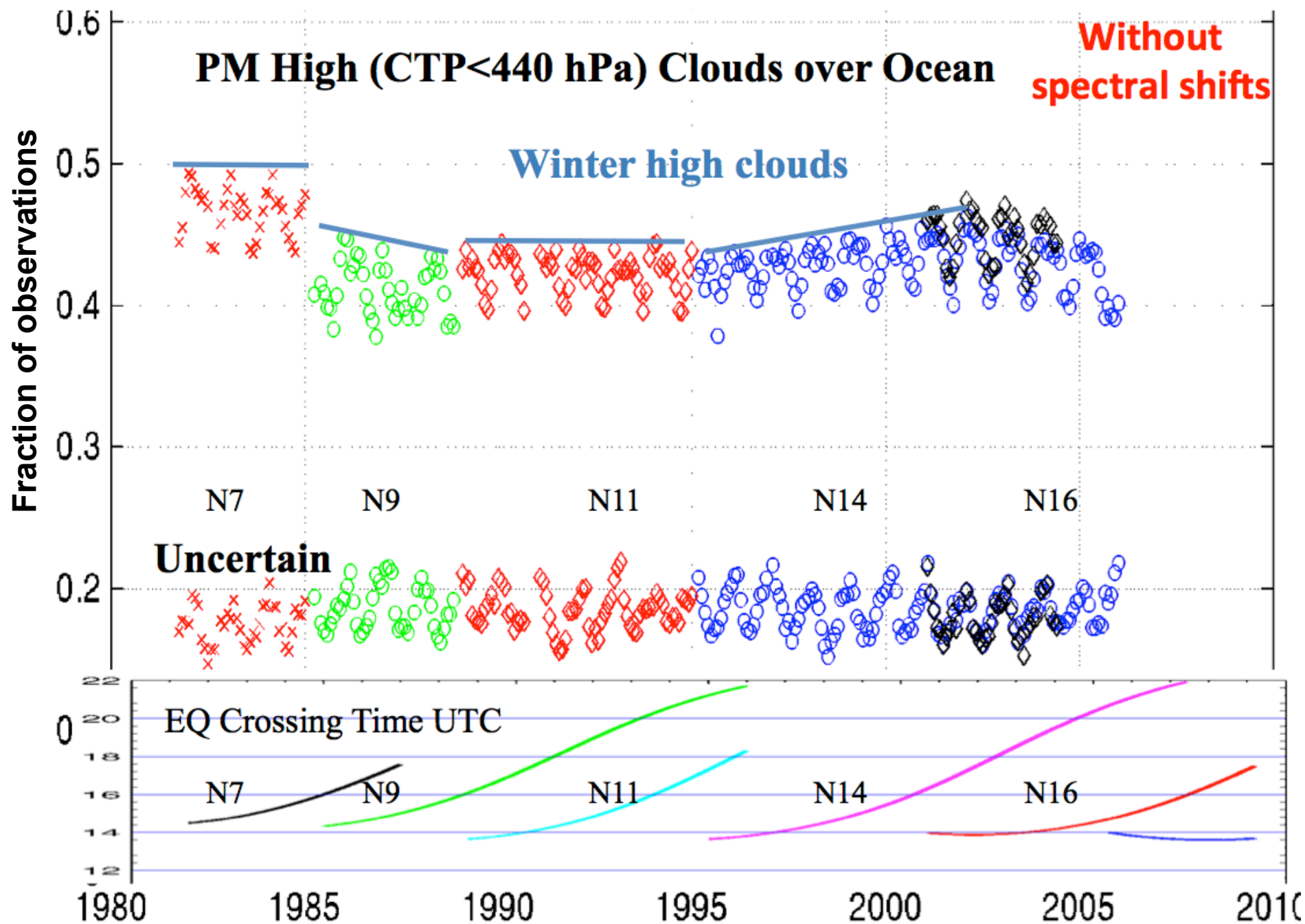


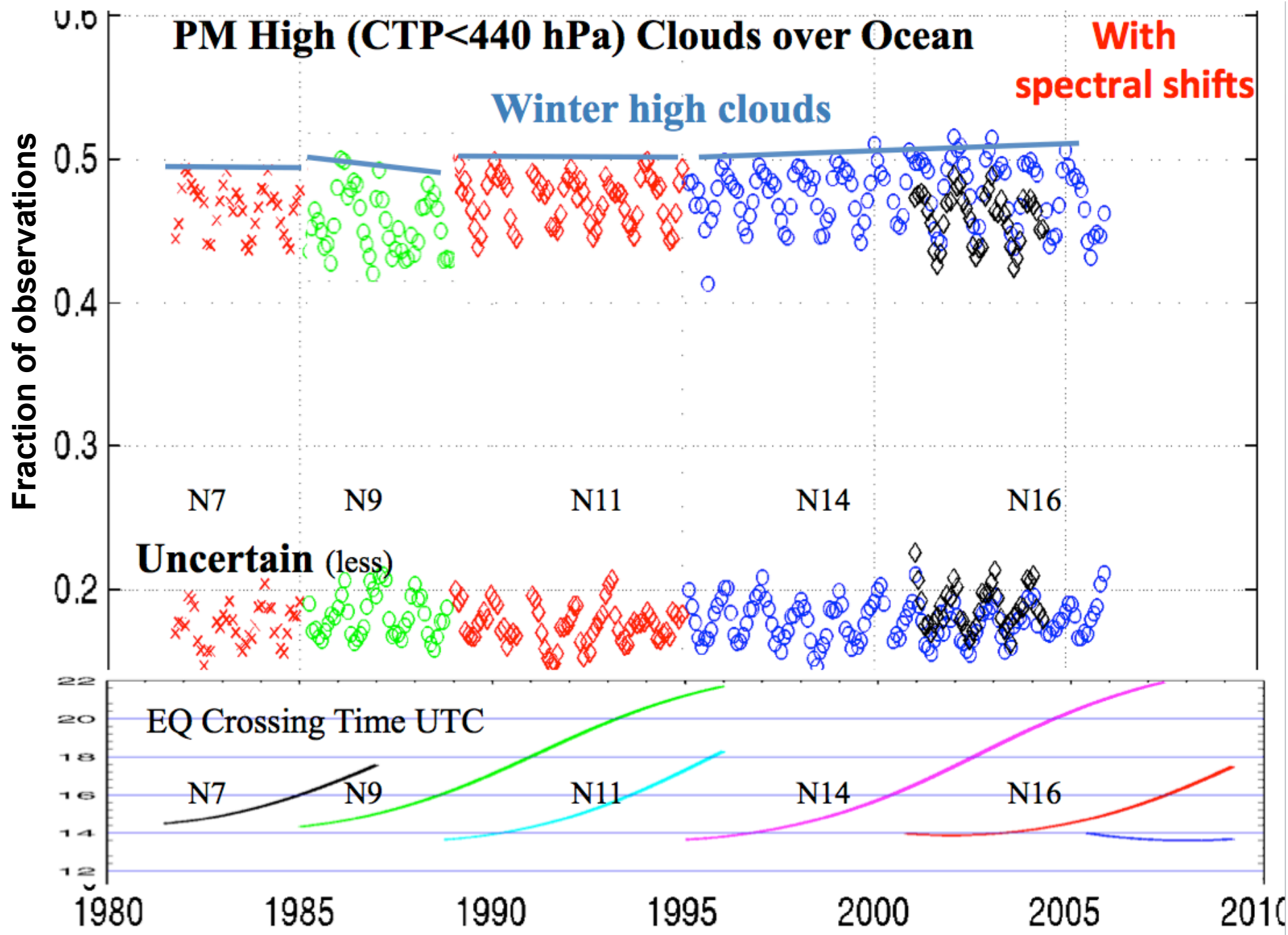
SNO: Simultaneous Nadir Overpass

Using IASI to Adjust HIRS SRF

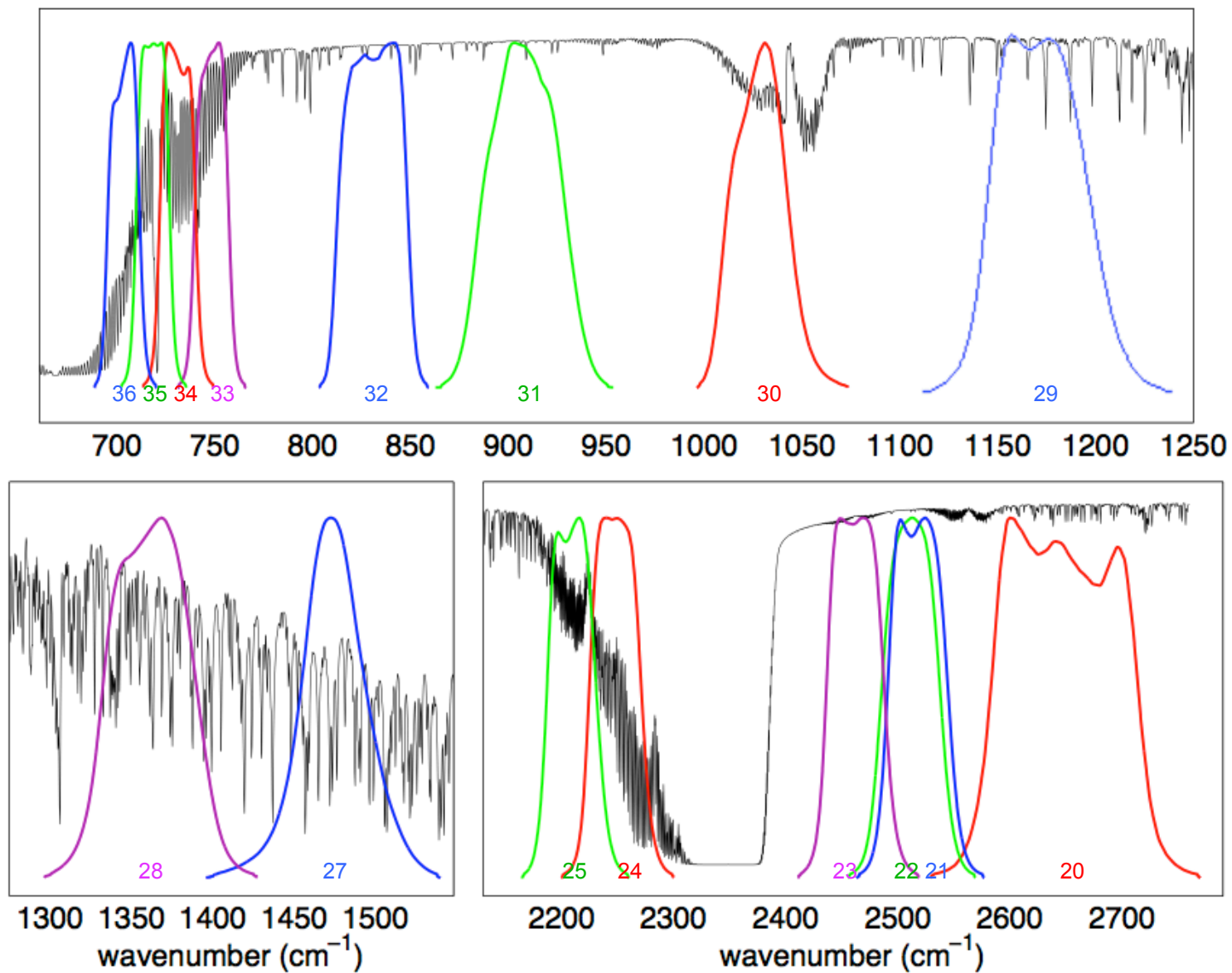


- * Bandwidth $\sim 15 \text{ cm}^{-1}$
- * Shift of 2.5 cm^{-1} , $\Delta T_b \sim +5 \text{ K}$, $\Delta R \sim 6 \text{ mW/m}^2/\text{ster/cm}^{-1}$
- * Then calculation of clear sky radiance obs would be off by ΔR which would affect determination of P_c
- * Warmer clear sky calculation introduces extra cloud detection

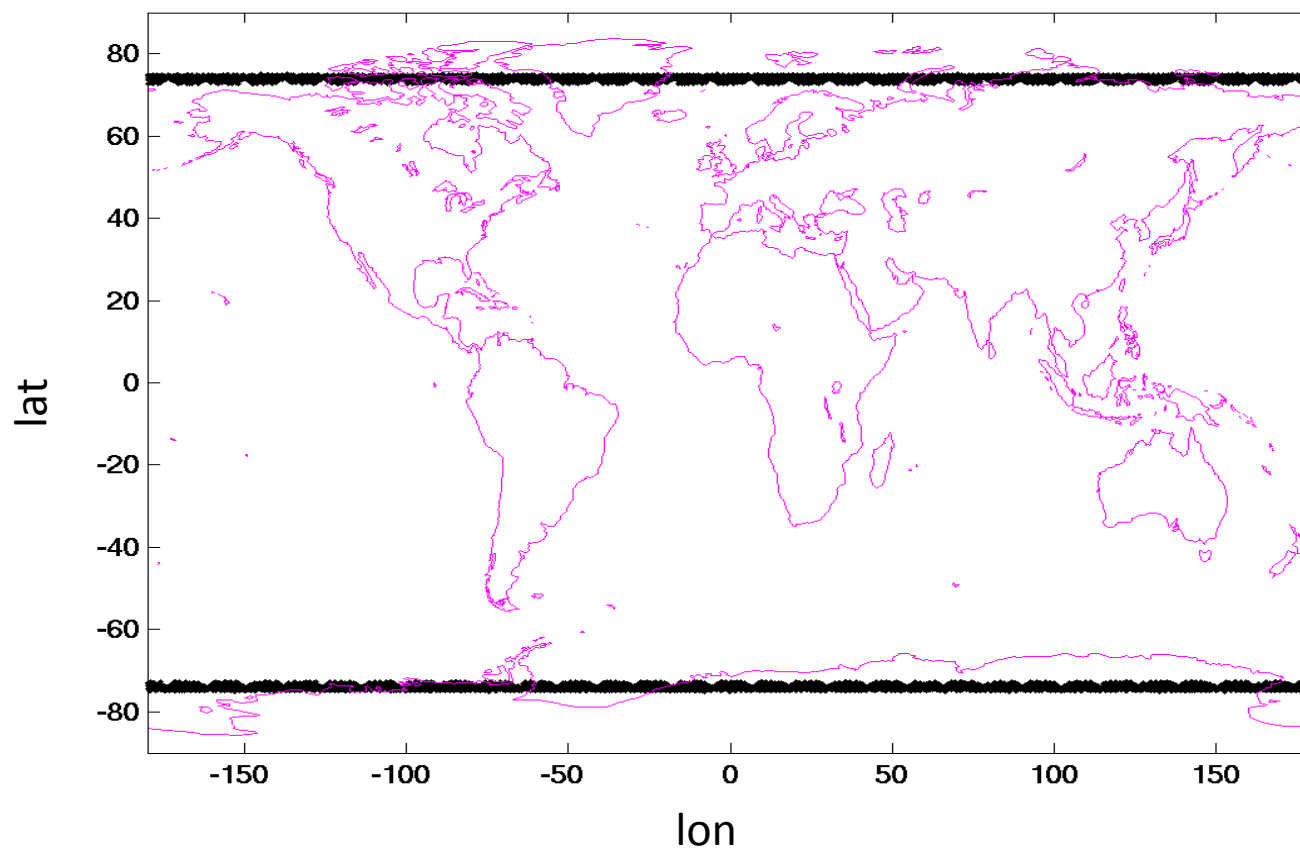




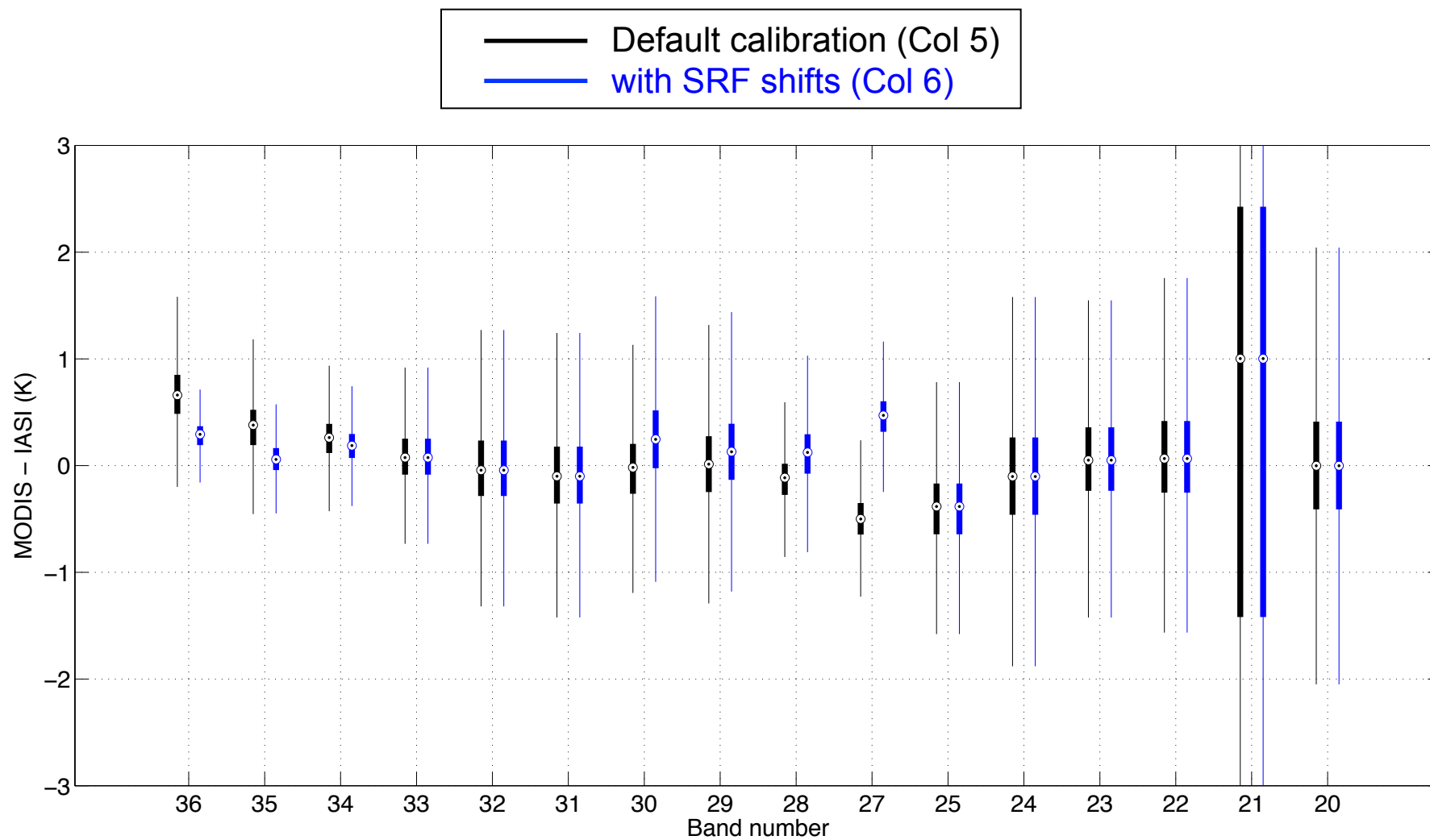
Intercalibration of Terra and Aqua MODIS with IASI



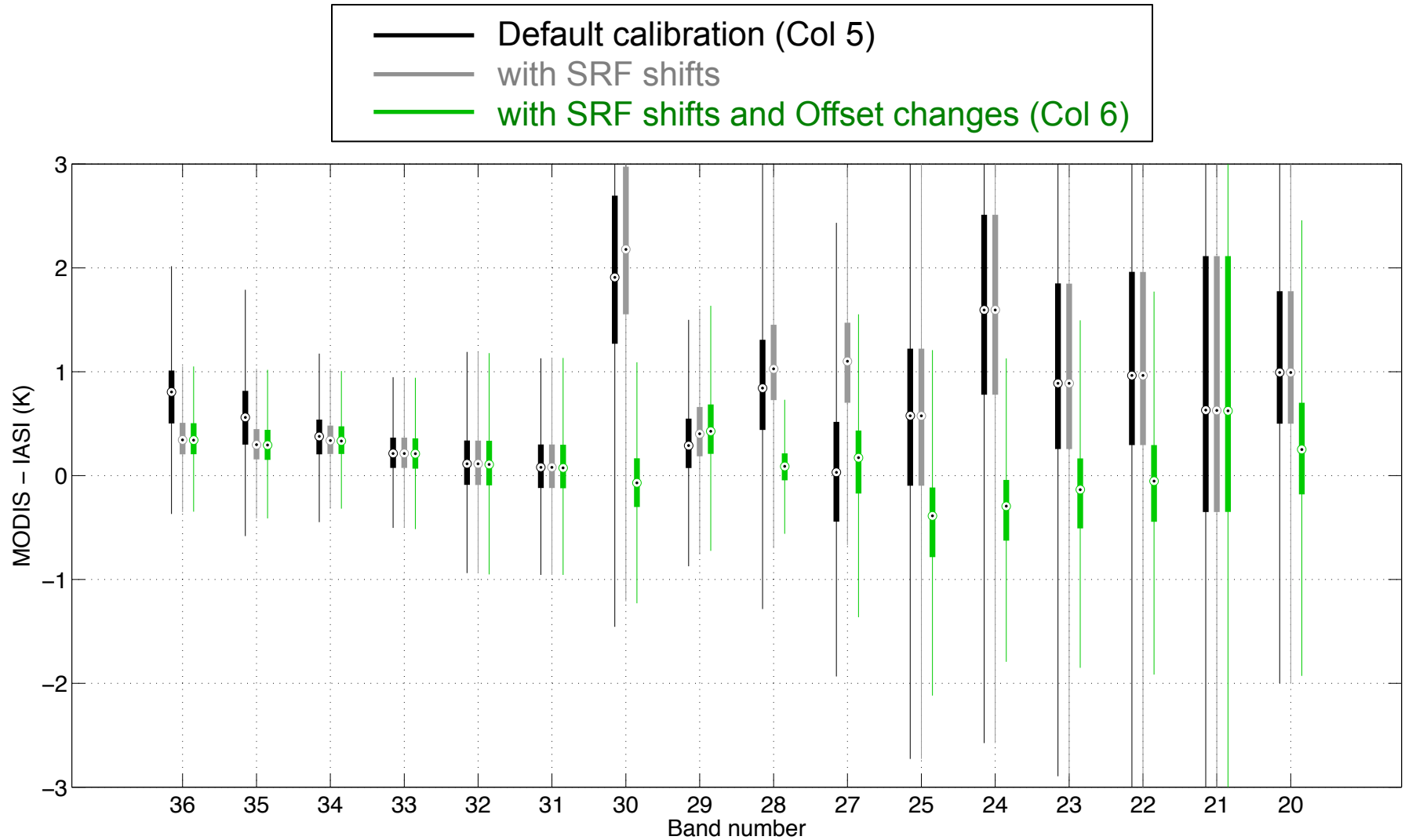
Intercalibration of Aqua MODIS with IASI



Aqua MODIS/IASI

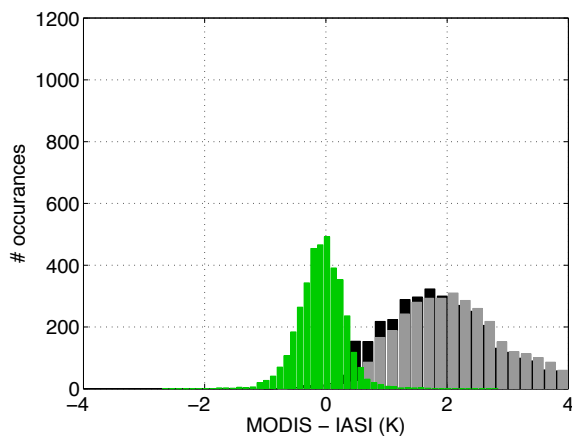


Terra MODIS/IASI

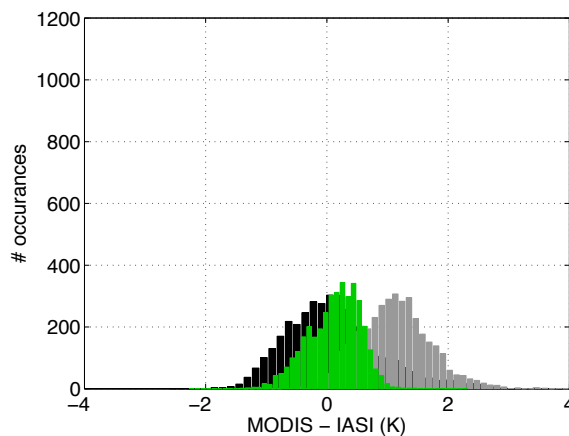


Terra MODIS/IASI

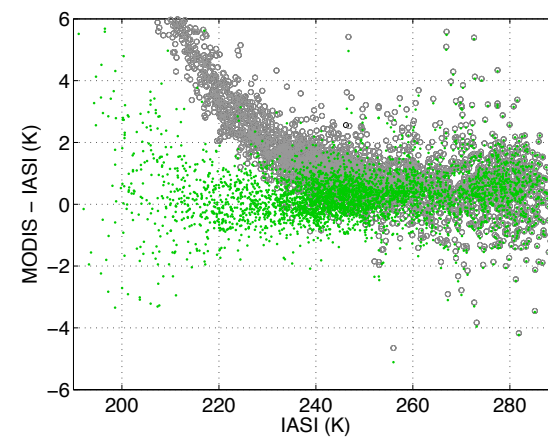
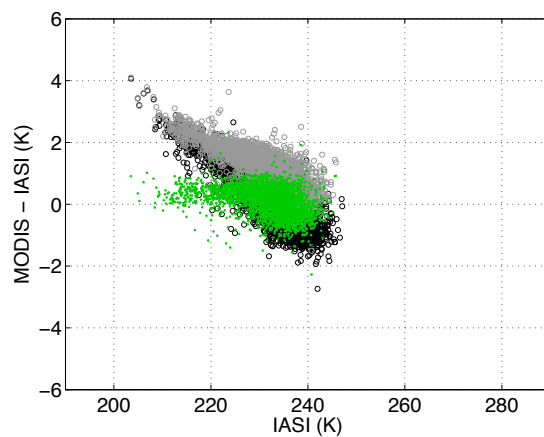
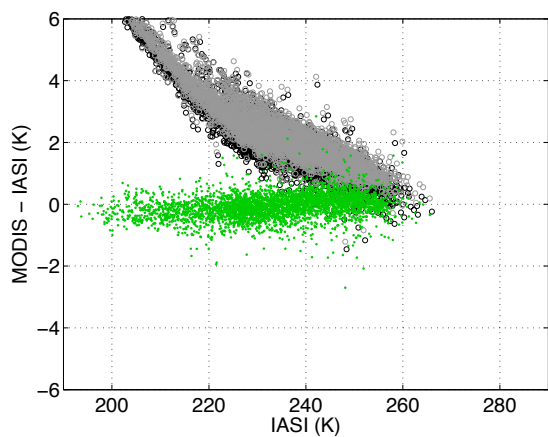
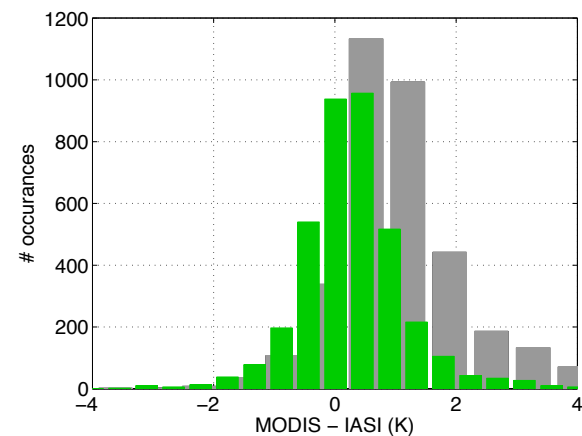
Band 30



Band 27

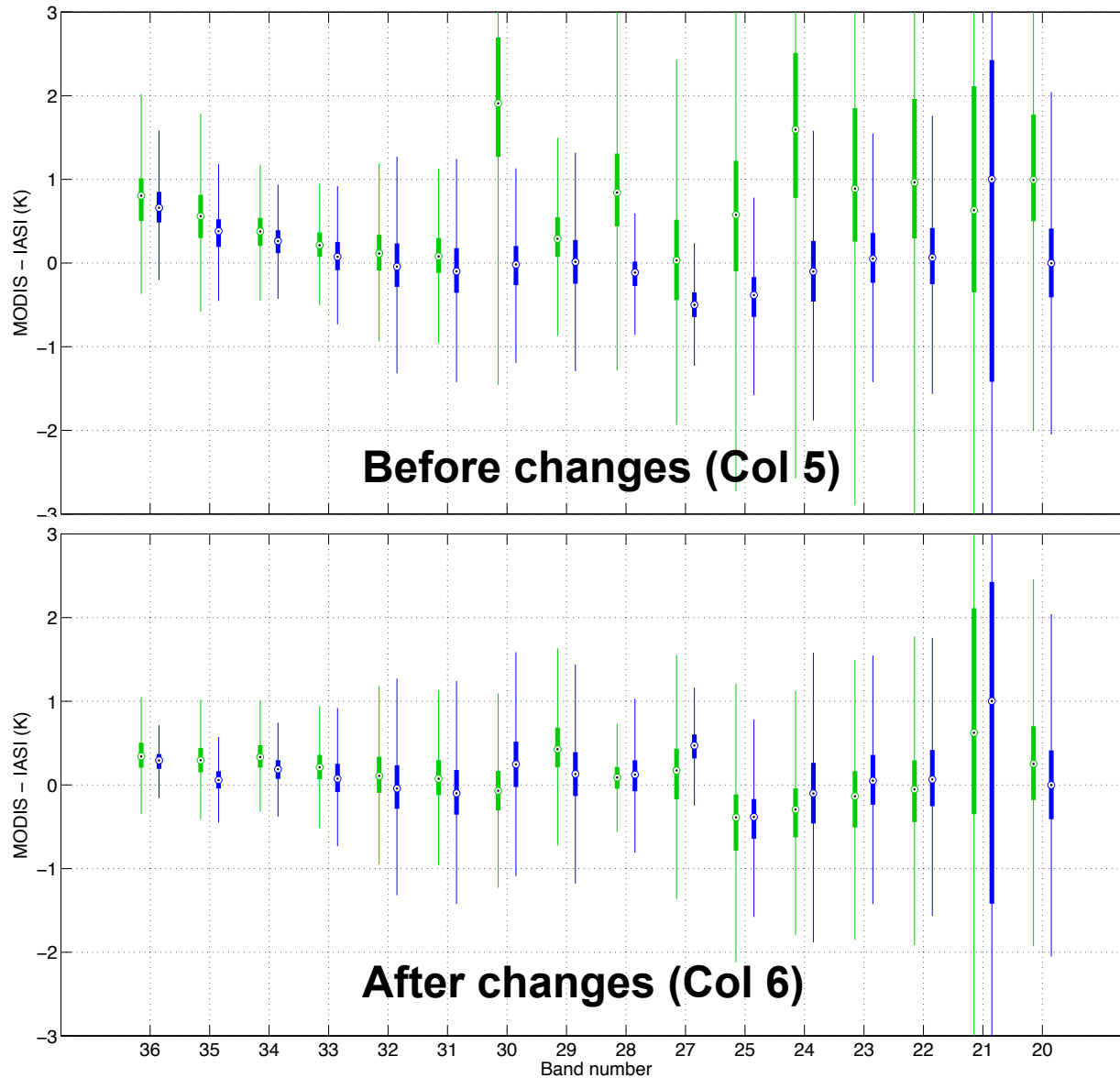


Band 20

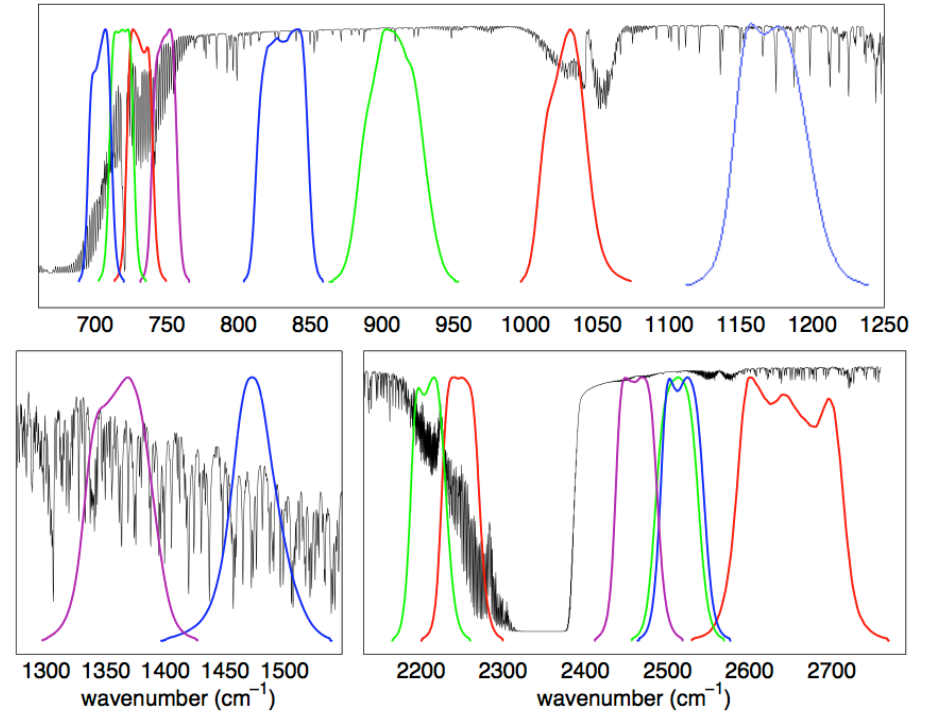
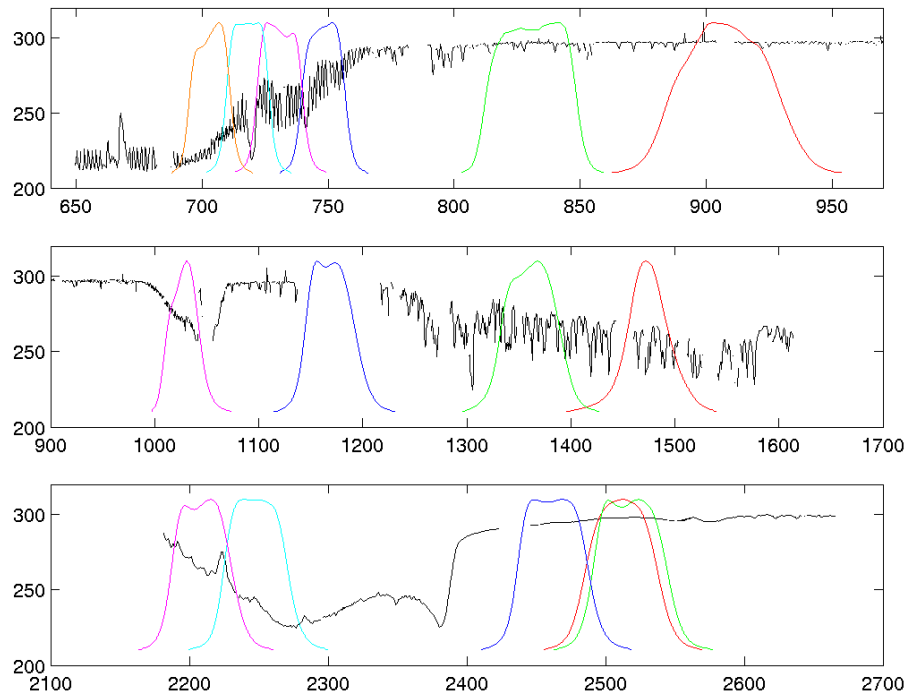


- Default calibration (Col 5)
- with SRF shifts
- with SRF shifts and Offset changes (Col 6)

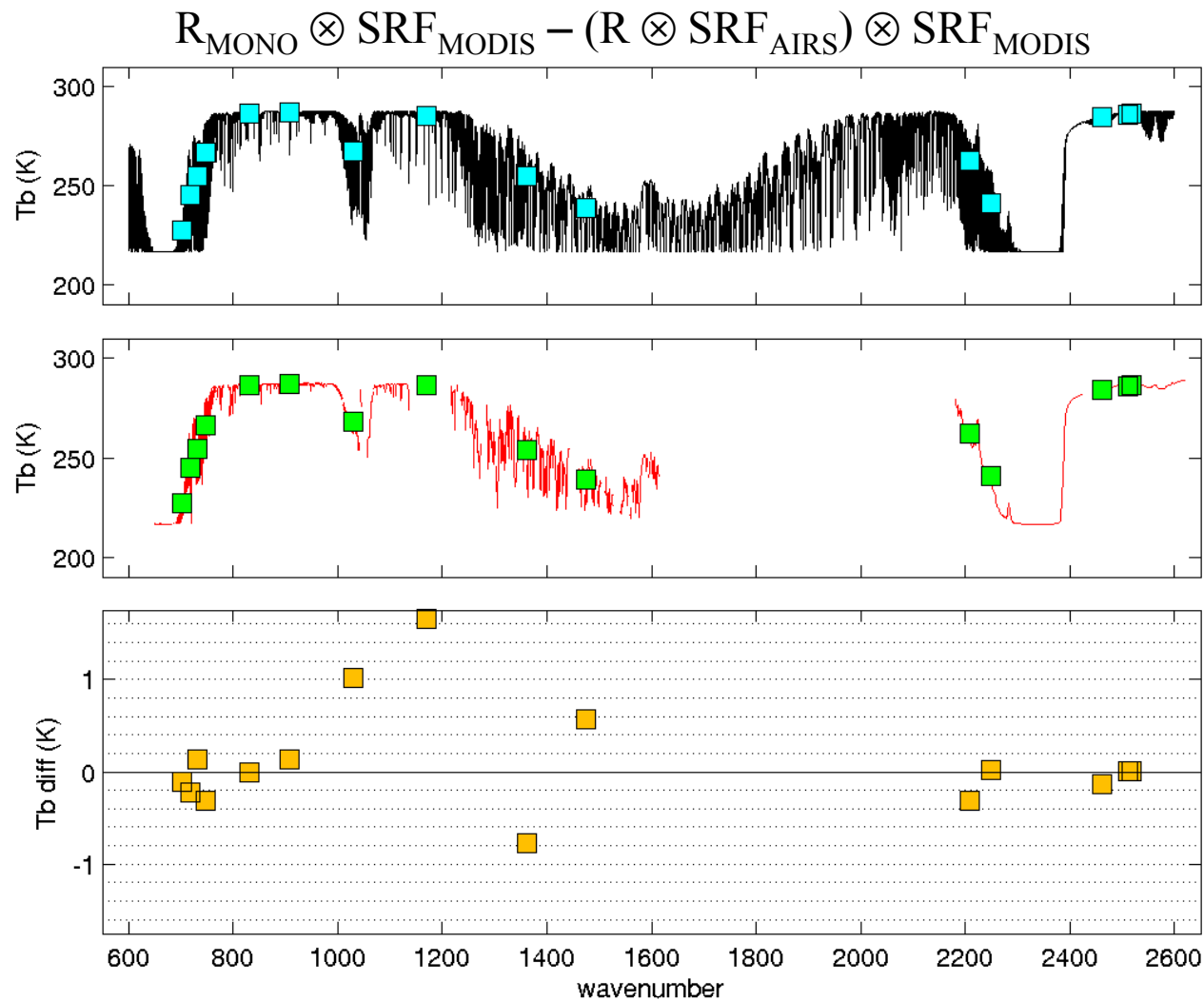
Aqua MODIS / Terra MODIS / IASI



AIRS vs. IASI: spectral

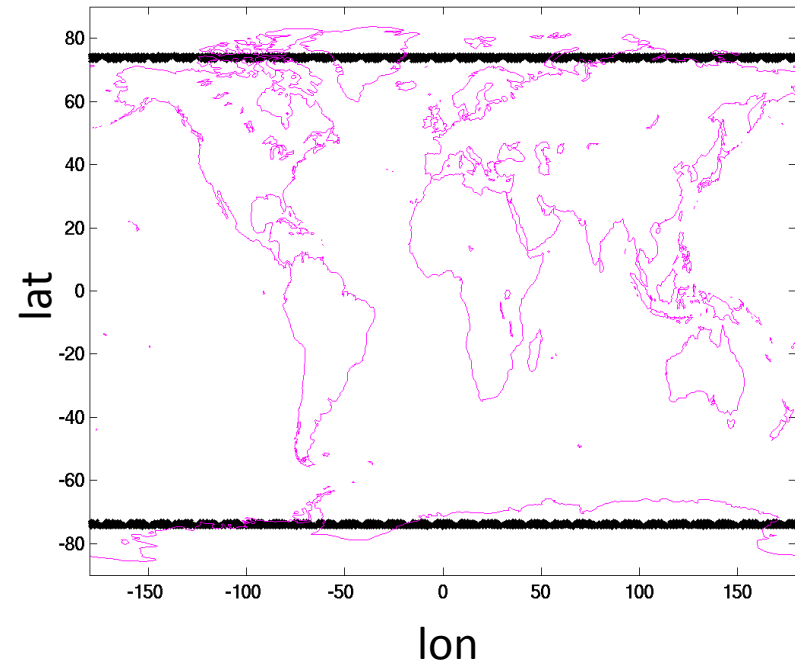
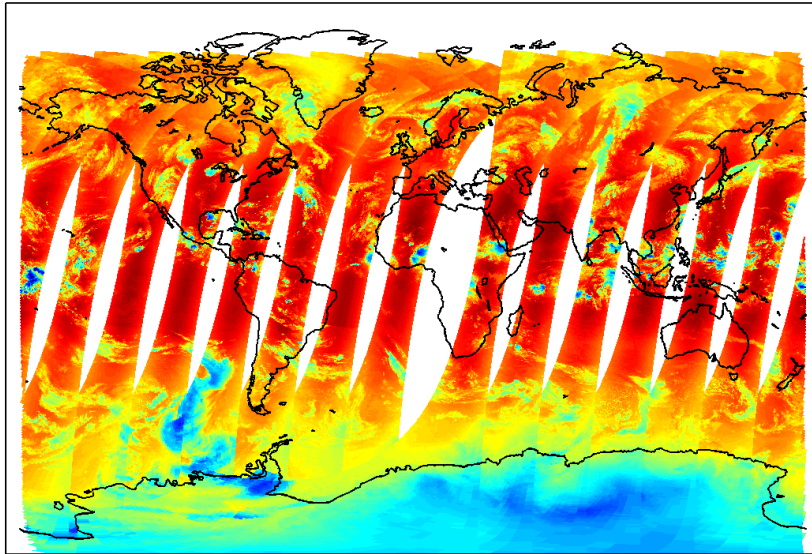


To match the MODIS spectral resolution, the AIRS spectra are convolved with the MODIS SRFs

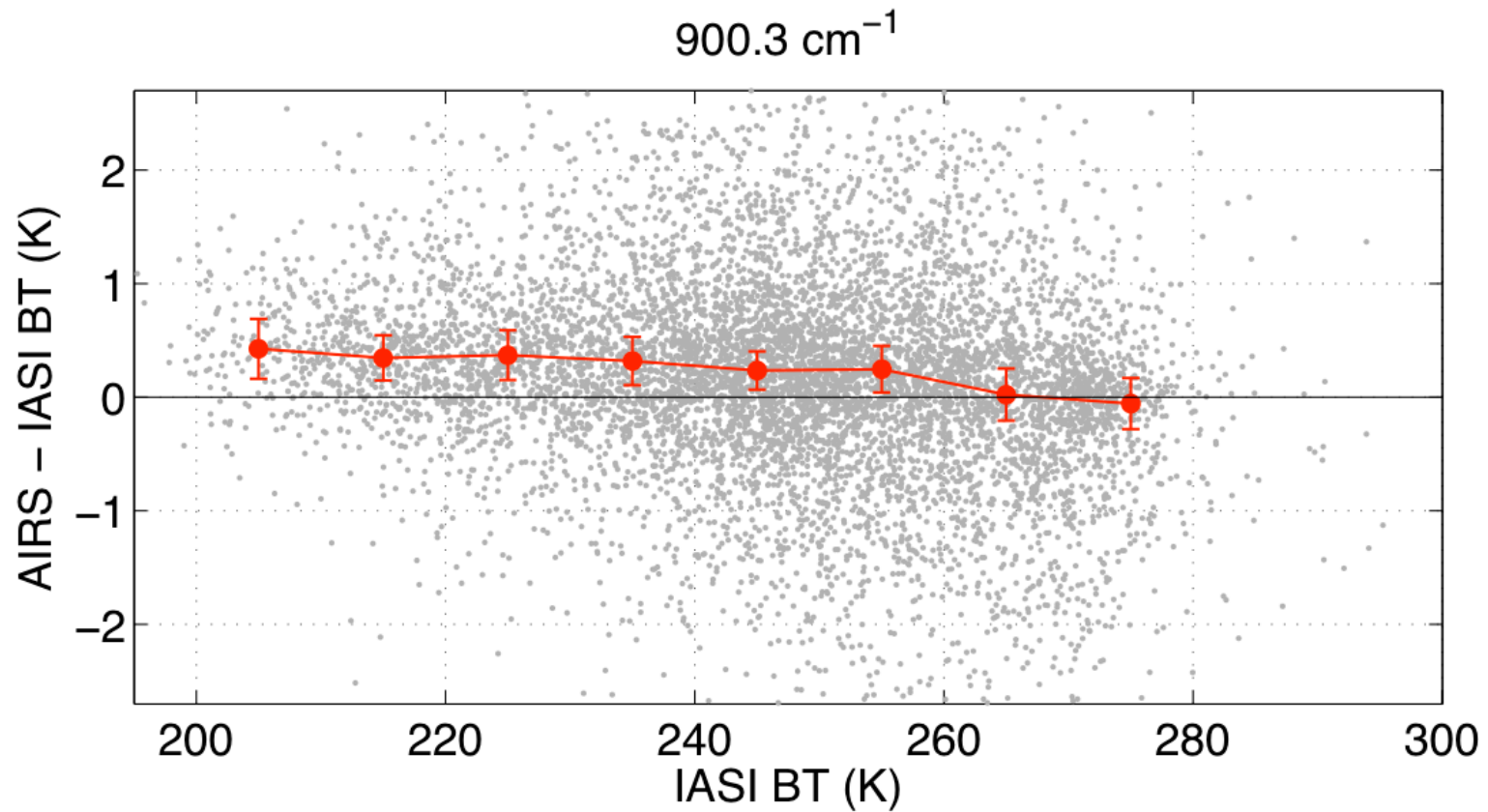


Correction factor that accounts for small gaps in AIRS spectra when convolving AIRS radiance spectra with the MODIS SRFs.

AIRS vs. IASI: Intercal sampling



AIRS vs. IASI: radiometric(?)



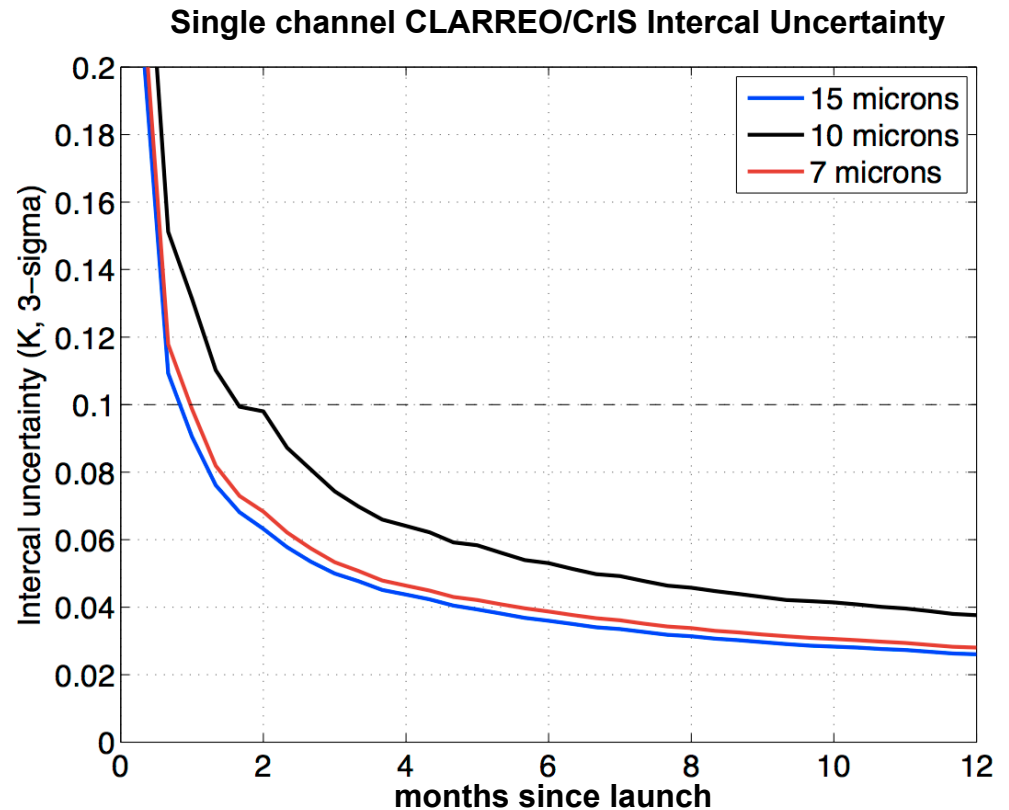
CLARREO for IR Intercal

- Complete, continuous spectral coverage and Nyquist sampling
- Good Intercal Spatial/Temporal sampling from 90° polar orbit
- High absolute accuracy and traceability

+

combined with many uses/users

=



IR Intercal is an attractive selling point for CLARREO.