Current CrIS Calibration Activities at UW-SSEC

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Polarization Correction

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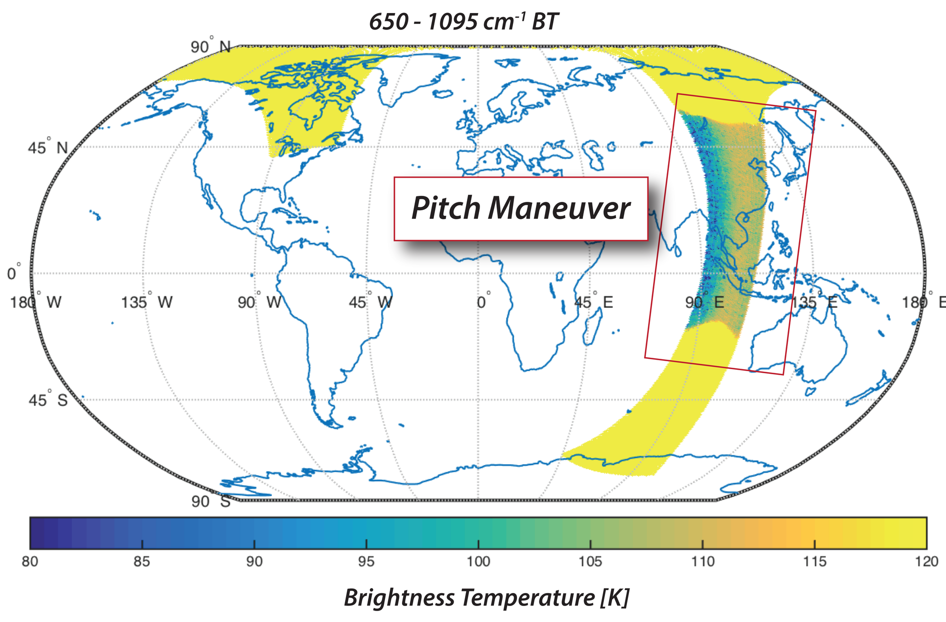
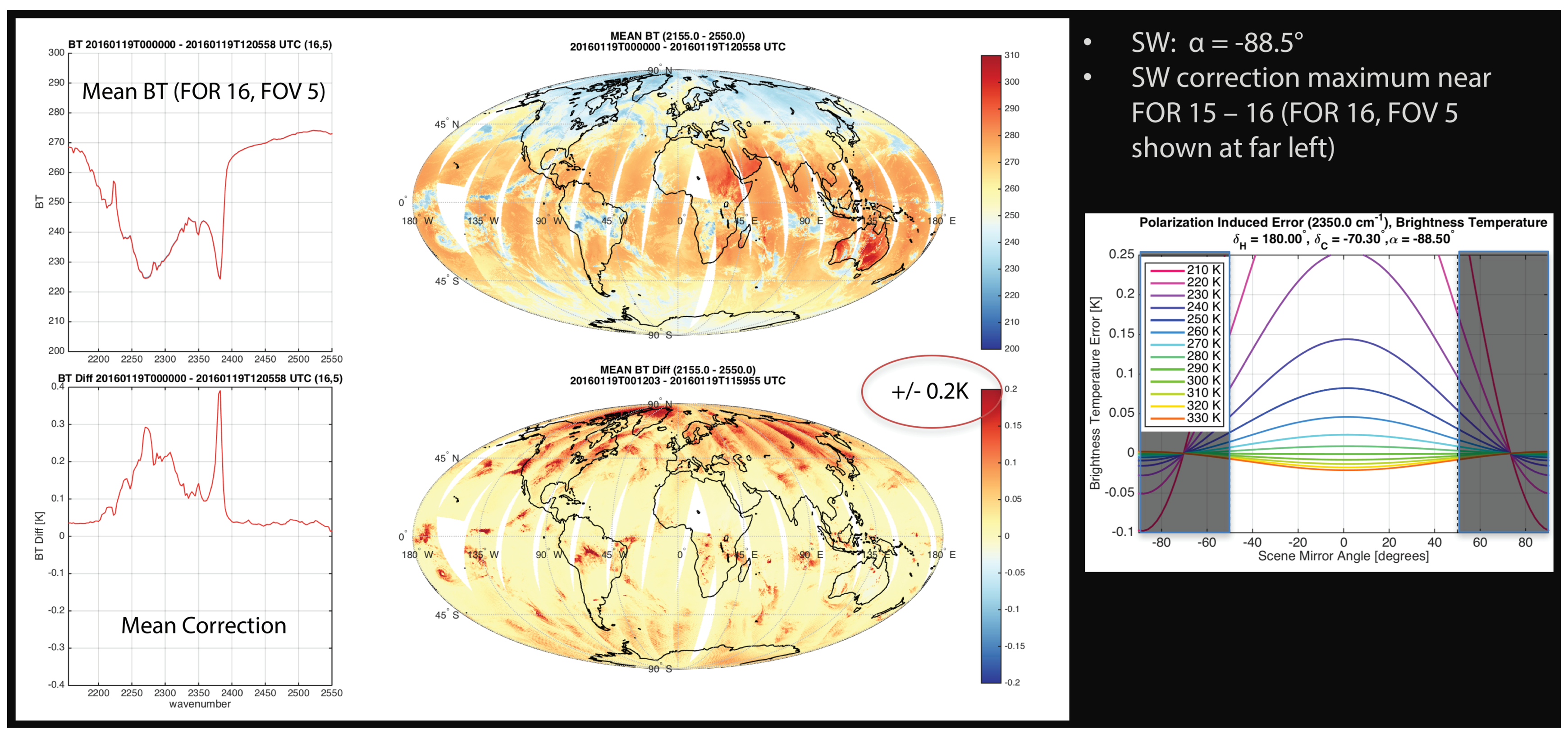
- Incident radiance is partially polarized by reflection from the scene select mirror (SSM); small degree of polarization in the IR for uncoated gold mirrors
- The orientation of the polarization axis of the scene select mirror changes with scene mirror rotation
- When coupled with the polarization sensitivity of the sensor, this produces a radiometric modulation of the detected signal that is dependent on the rotation angle of the scene select mirror and creates a calibration error



"Earth view" data of deep space at multiple view angles collected during the spacecraft pitch maneuver (2012-02-20) has been used to characterize the polarization effects of S-NPP CrIS

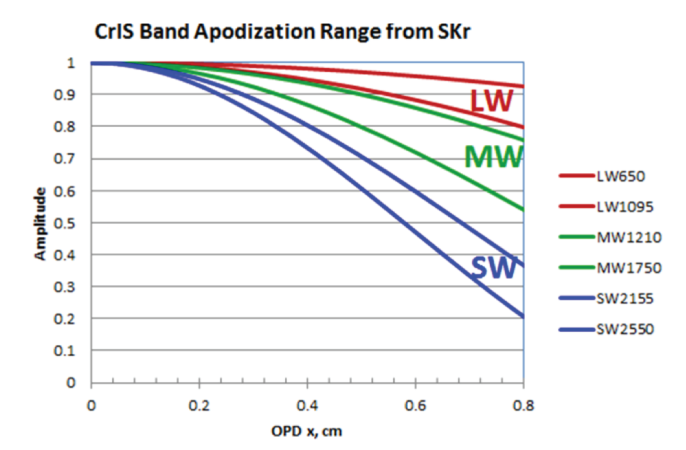


- A polarization correction module has been integrated into our processing
- $p_r p_t$ and α values have been derived from pitch maneuver data
- An example of the correction for 12 hours of data (2016-JD019) illustrates:
  - Mean correction is largest in SW (when expressed as brightness temperature), and approaches 0.3 – 0.4 K for 220 – 230K scene temperatures.
  - Mean correction in SW show very similar behavior to CrIS – IASI SNO residuals
  - Mean correction in LW and MW are relatively small, but not insignificant for cold scenes
- Next Steps include: (1) Test impact on SNOs, CrIS – VIIRS, and obs-calc; (2) Further refinements to α and $p_r p_t$; (3) Radiometric uncertainty analysis for correction

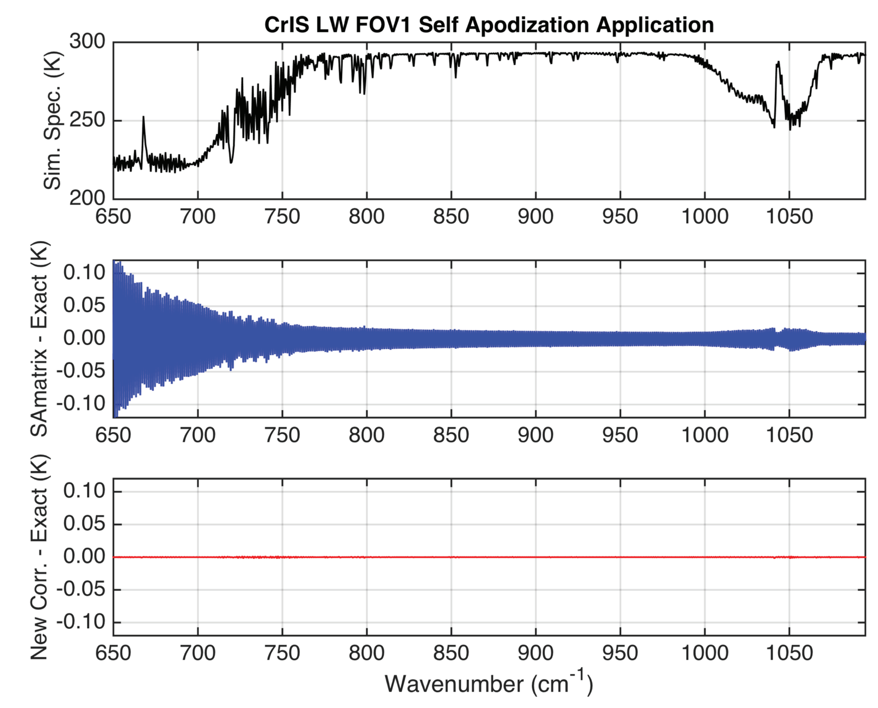
A New Approach to CrIS SA Correction

point of contact: Hank Revercomb, hank.revercomb@ssec.wisc.edu

- The well-known self-apodization affect broadens the Instrument Line Shape (ILS) of CrIS off-axis pixels. To make spectra from all 9 fields-of-view interchangeable, a well-defined matrix inverse is applied. While this approach works remarkably well, some ringing artifacts result and its absolute accuracy is hard to confirm.
- We have developed a new, rigorous correction to address both of these issues
- The correction in the interferogram domain takes the form of several terms of a Taylor series expansion
- Each term is rigorously expressed in terms of Fourier transformations



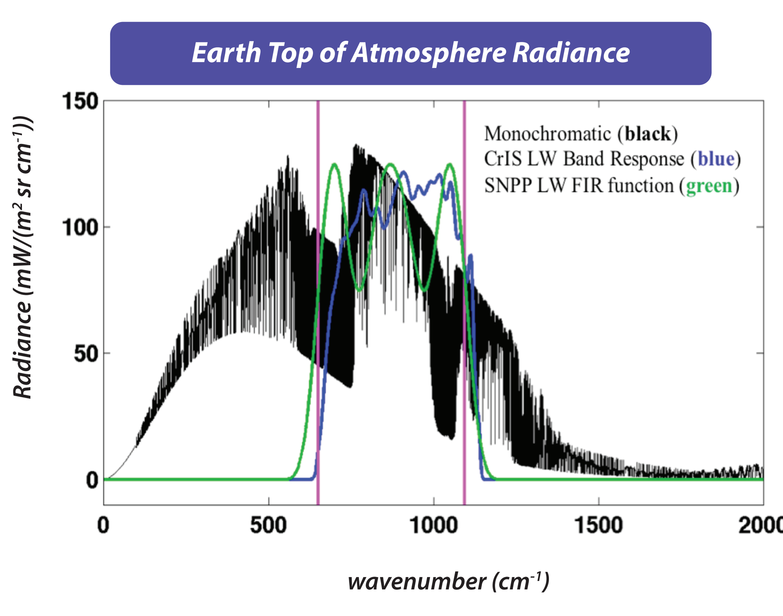
The interferogram apodization shown in the figure is defined by a spectral Kernel in the new algorithm, and is corrected for using Fourier transformations and a separate well-defined spectral scale shift

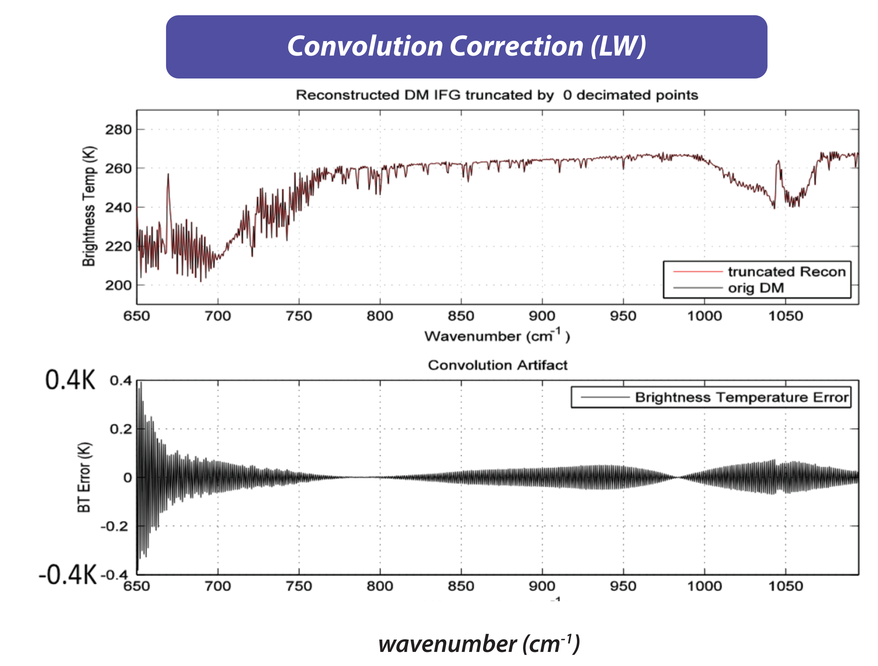


Spectral Ringing Correction and Validation

point of contact: Bob Knuteson, robert.knuteson@ssec.wisc.edu

- The CrIS LW detector response falls rapidly to zero near the center of the 15 micron CO_2 band
- This causes issues near the LW band edge in the raw radiances, requiring apodization to remove ringing
- We have developed a method to correct for LW band edge errors thereby improving the unapodized SDR product

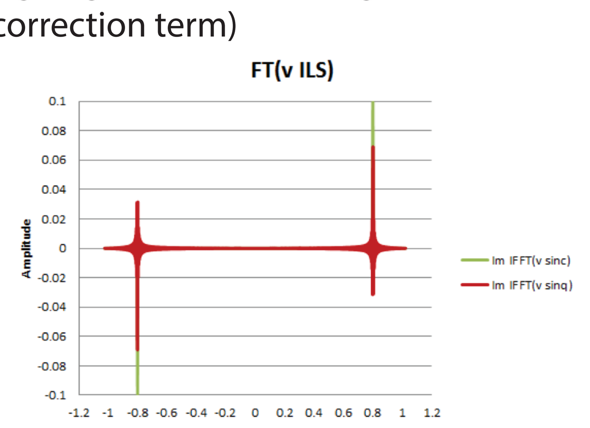


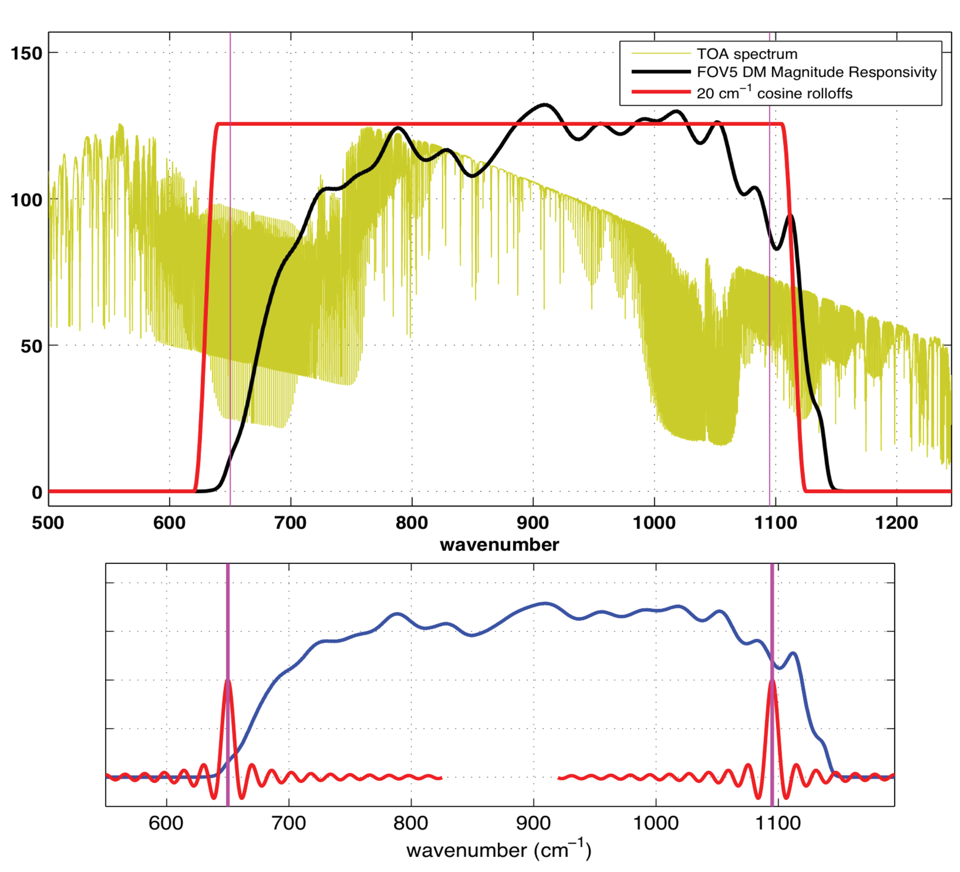


Removal of CrIS Spectral ILS Dependence on Responsivity

point of contact: Hank Revercomb, hank.revercomb@ssec.wisc.edu

- CrIS radiances currently have a spectral Instrument Line Shape (ILS) with a very weak dependence on responsivity, arising from the non-flatness of the responsivity and its finite bandpass
- The effect adds subtle ringing to CrIS spectra (referred to as "true" ringing)
- To avoid errors from this "true" ringing, calculated spectra used for retrievals and assimilation must also use the responsivity
- We are developing a new, efficient, and accurate approach to eliminate this type of responsivity dependence
- Correction terms modify the ends of interferograms, I(x), as needed to remove ringing (e.g. shown in the figure below for the first correction term)

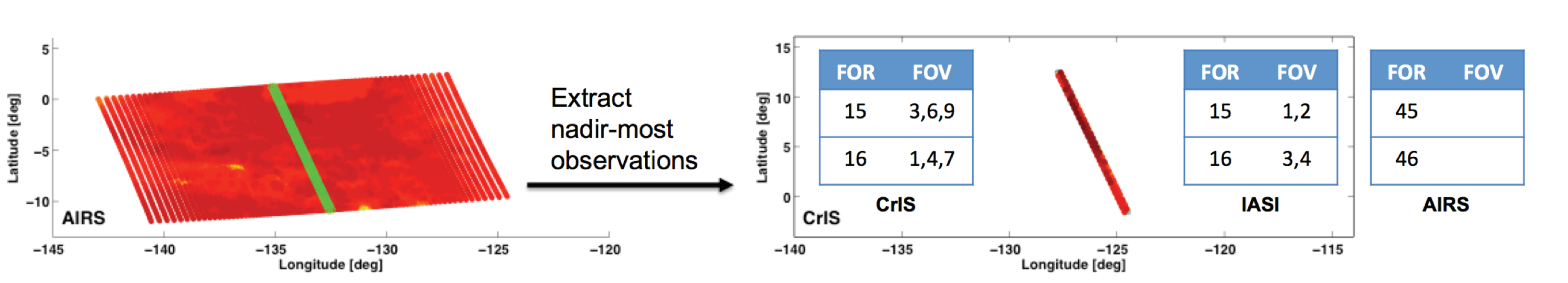




Detecting Climate Trends Using AIRS, IASI, and CrIS BTs

point of contact: Dan DeSlover, dan.deslover@ssec.wisc.edu

- Extract near-nadir observations (AIRS field-of-regard 45 & 46; CrIS and IASI FOR 15 & 16 using the innermost FOVs); full-resolution stored into daily files



FOR	FOV
15	3,6,9
16	1,4,7

CrIS

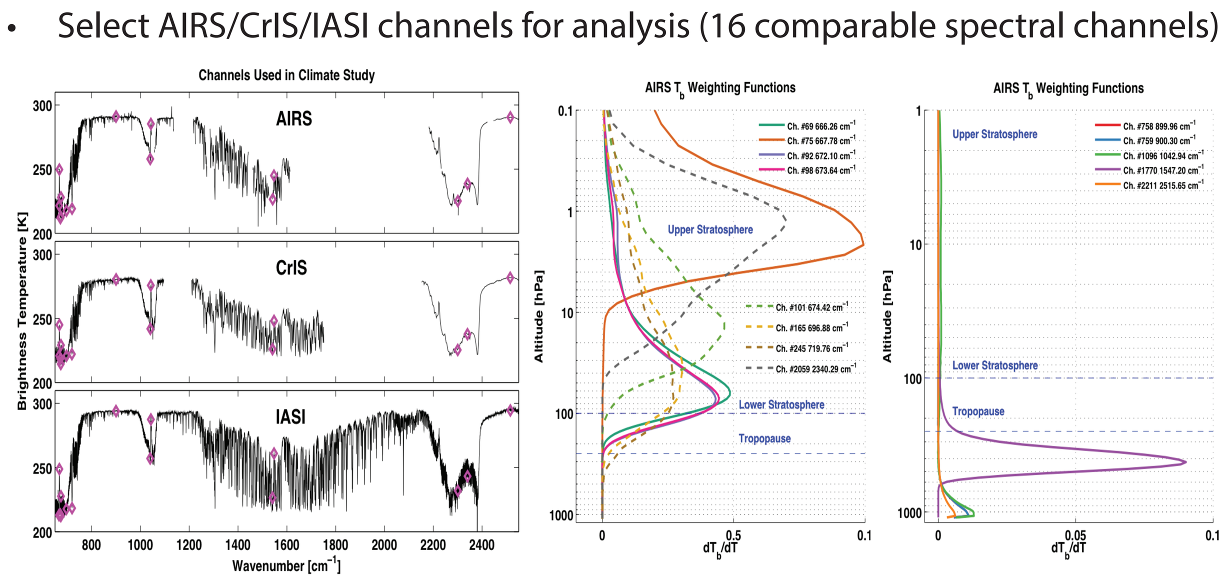
FOR	FOV
15	1,2
16	3,4

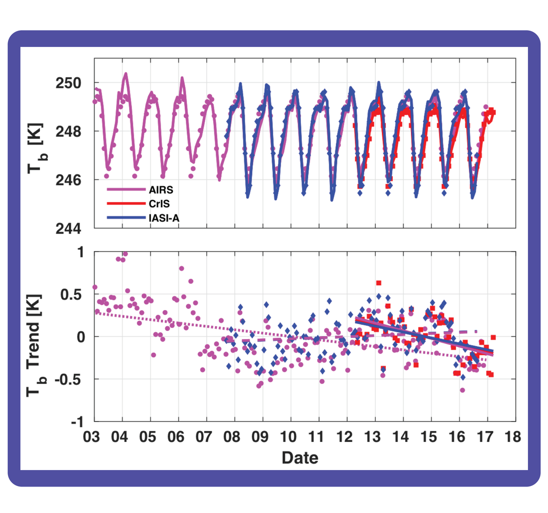
IASI

FOR	FOV
45	
46	

AIRS

- Select AIRS/CrIS/IASI channels for analysis (16 comparable spectral channels)





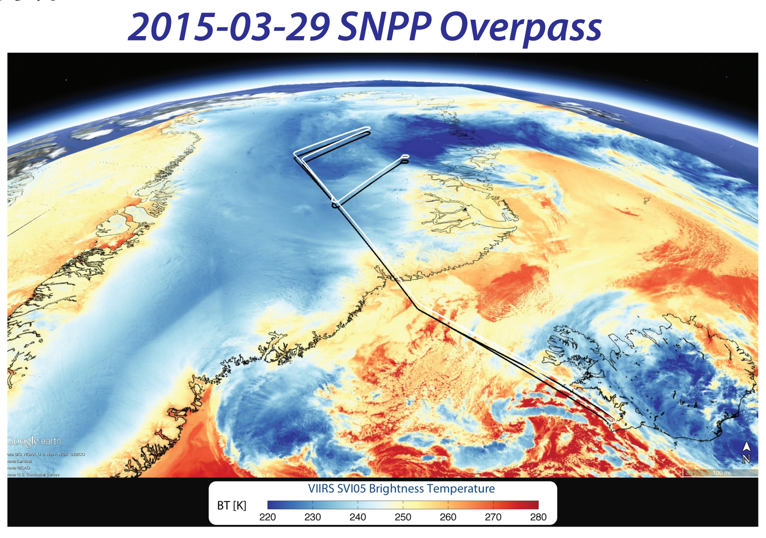
Airborne Cal-Val with the UW-SSEC S-HIS

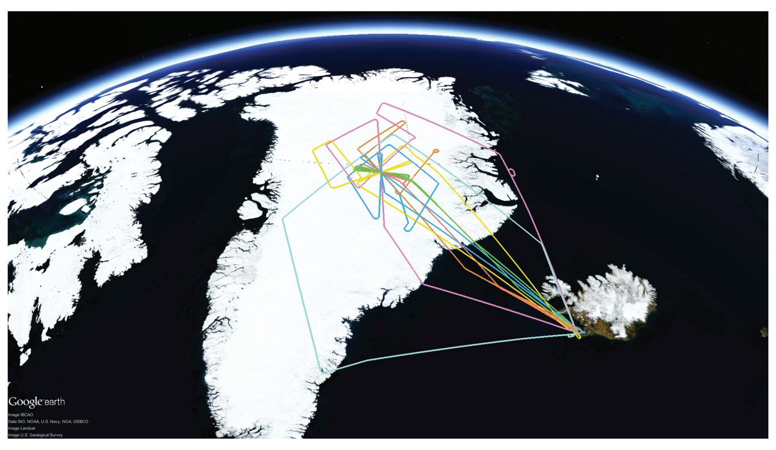
point of contact: Joe Taylor, joe.taylor@ssec.wisc.edu

- Recent S-HIS airborne Cal-Val campaigns: SNPP 2015 (Keflavik Iceland), GOES-16 PLT 2017 (Palmdale CA and WRB AFB GA, included SNPP underflights); S-HIS uptime > 99%

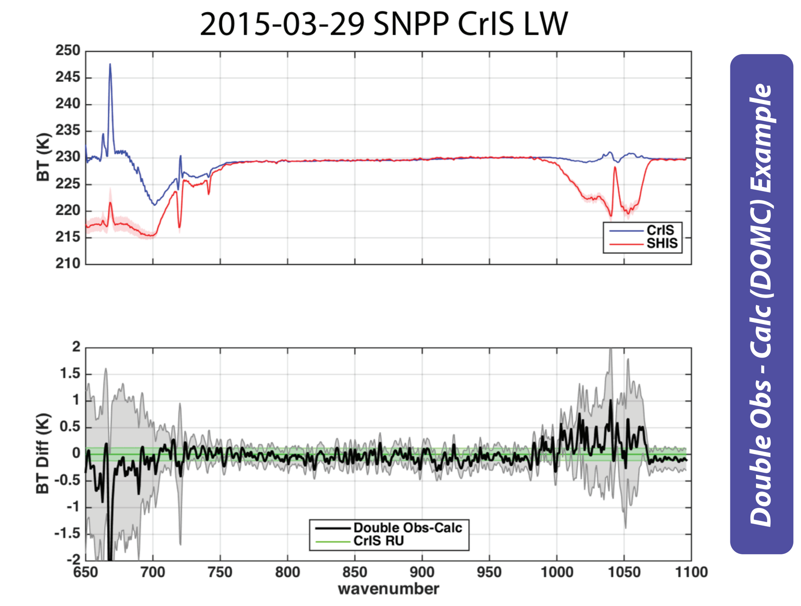
2015-02-23	Engineering test flight; SNPP
2015-03-07	Transit flight
2015-03-15	SNPP, METOP-B, SNPP
2015-03-19	Multiple passes over Greenland Summit Station
2015-03-23	METOP-A, SNPP, Aqua
2015-03-24	SNPP • poor scene conditions for SNPP radiance comparison
2015-03-25	METOP-A, SNPP, METOP-B, Aqua • poor scene conditions for SNPP radiance comparison
2015-03-28	SNPP, SNPP
2015-03-29	Aqua, METOP-A, METOP-B, SNPP
2015-03-31	Transit flight

2015-03-29 SNPP Overpass

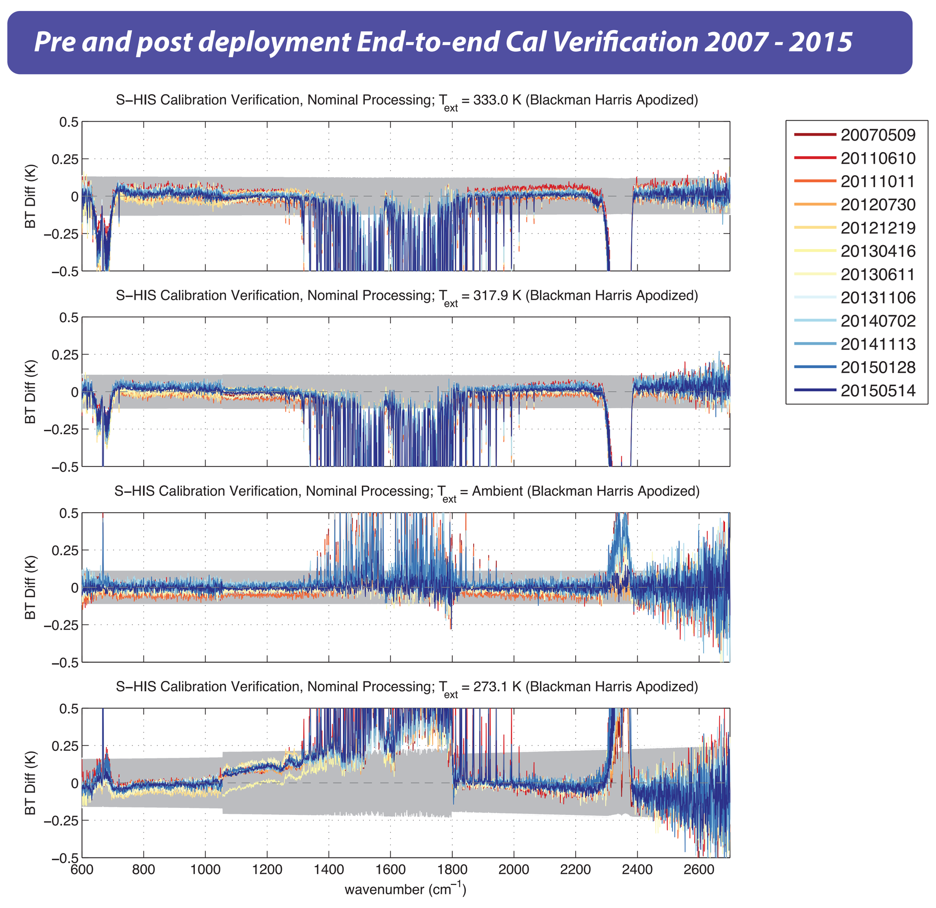


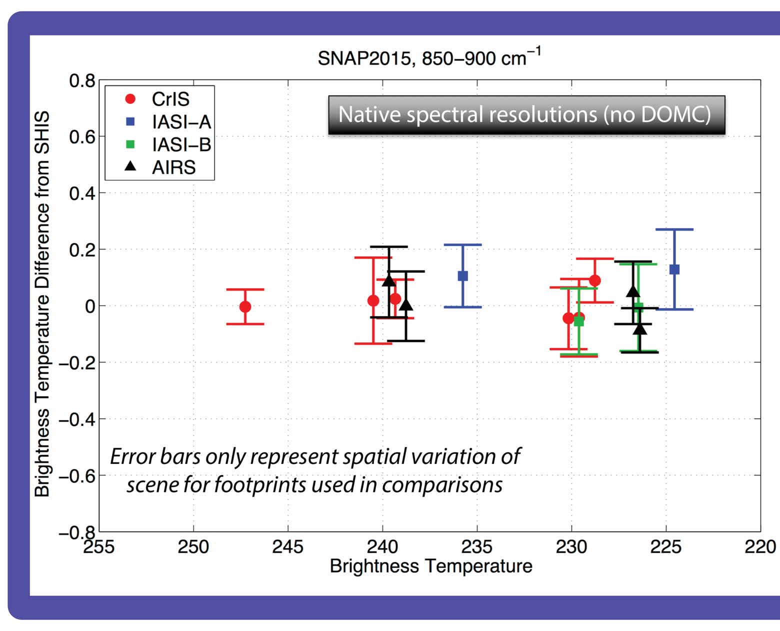


2015-03-29 SNPP CrIS LW



Pre and post deployment End-to-end Cal Verification 2007 - 2015





S-HIS Calibration, Calibration Verification, and Traceability

- Pre-integration calibration of on-board blackbody references at subsystem level
- Pre and post deployment end-to-end calibration verification
- Periodic end-to-end radiance evaluations under flight like conditions with NIST transfer sensors.
- Instrument calibration during flight using two on-board calibration blackbodies