Cal/Val of CrIS on Suomi-NPP: Intercalibration with AIRS, IASI, and VIIRS

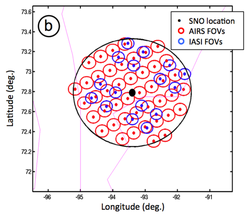
David C. Tobin, Henry E. Revercomb, Fred A. Best, Joe K. Taylor, Robert O. Knuteson, Daniel H. DeSlover, Lori A. Borg, Chris Moeller, Graeme Martin, Ray Garcia
Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center, University of Wisconsin-Madison

"Big Circle" SNO Approach

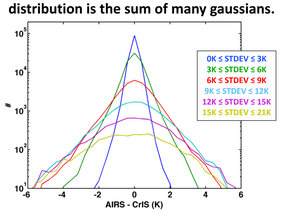
CrIS/AIRS, CrIS/IASI, and AIRS/IASI comparison approach for Simultaneous Nadir (and off-nadir) Overpasses:

- AIRS, CrIS, and/or IASI data within large ellipsoids (100 km at nadir) centered on each SNO point are gathered.
- Mean spectra and StdDev of spectra are recorded for each SNO. The spatial standard deviation is the primary source of comparison error for any given SNO.
- Weighted mean and weighted mean uncertainties are computed for the ensemble of SNOs, using the spatial standard deviations to compute the weights. This is performed independently for each spectral channel.
- Advantage of this type of analysis is that the comparisons are not dependent on knowledge of the atmospheric state, radiative transfer algorithms, cloud screening, surface characterization, precise geolocation, …

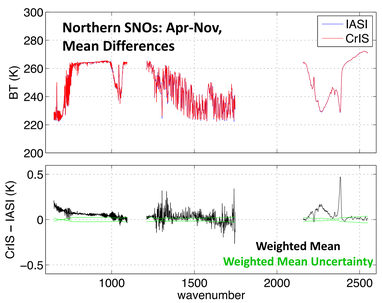
Example AIRS/IASI SNO

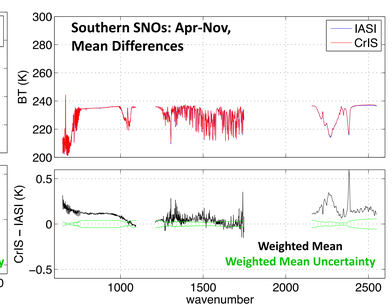


Distributions of 835 cm^{-1} AIRS-CrIS differences, segregated by scene non-uniformity. The full distribution is the sum of many gaussians.

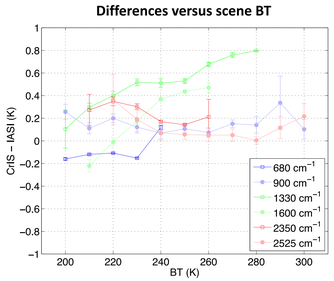


CrIS/IASI

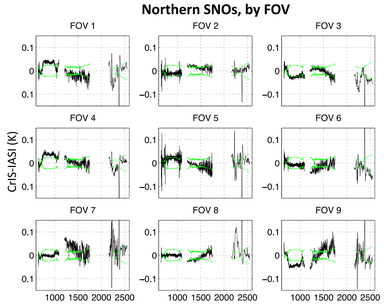




Differences versus scene BT



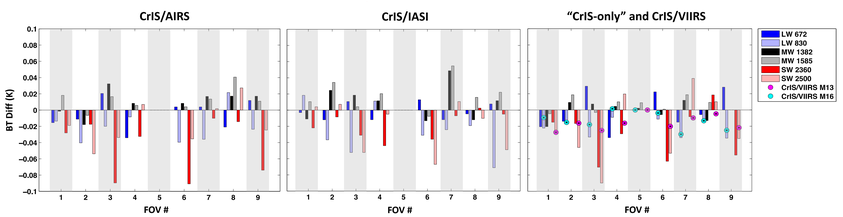
Northern SNOs, by FOV



Weighted Mean (FOV i) minus Weighted Mean (all FOVs)
Weighted Mean Uncertainty

FOV-2-FOV Radiometric Differences

with respect to FOV5



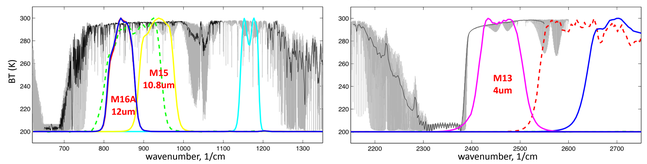
SUMMARY

- Intercalibration techniques such as sounder/imager and sounder/sounder SNO techniques applied to high spectral resolution observation allow biases to be assessed at the sub 0.1K level, and are a key part of the CrIS post-launch Cal/Val efforts.
- Comparisons of CrIS with IASI, AIRS, and VIIRS show agreement on the 0.1 to 0.2K level for the large majority of spectral channels and scenes. Larger differences for some spectral regions/scenes are currently being investigated.
- CrIS FOV-2-FOV differences are less than ~30mK for most spectral channels and FOVs; larger differences for some FOVs/spectral regions are also under investigation.

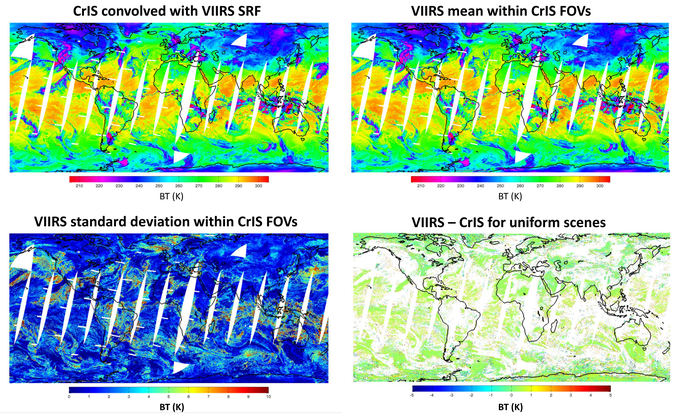
- Thanks very much to NOAA and NASA, to the CrIS SDR Cal/Val group, and to the Atmosphere PEATE at UW-Madison for their support of this work.

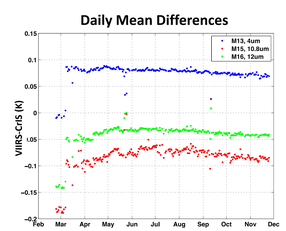
CrIS/VIIRS

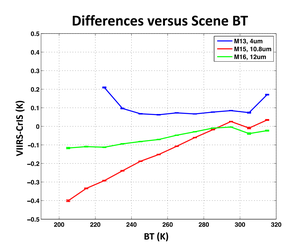
Monochromatic spectrum, CrIS spectrum, and VIIRS SRFs

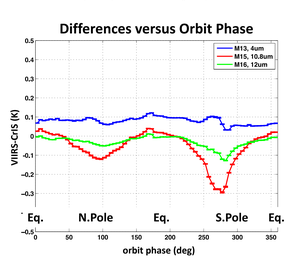


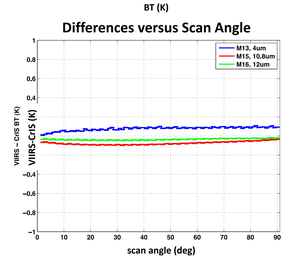
Example Daily images, M15 band, nighttime





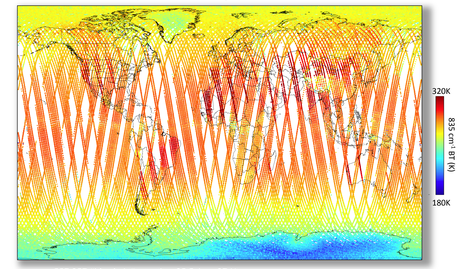






CrIS/AIRS

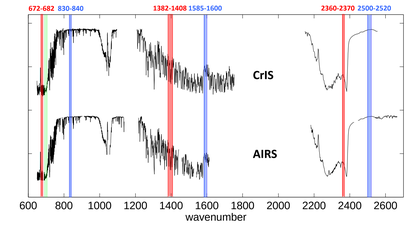
CrIS/AIRS Matchups, 25 Feb to 27 Nov



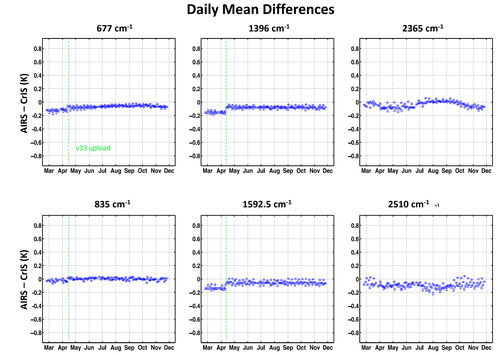
- 557,357 "big circle" samples, 25 Feb to 27 Nov
- Scan angles ≤ 30°; Scan angle difference ≤ 3°; Time Diff <= 20 min
- AIRS data is L1B v5; CrIS data is ADL (CSPP v1.1) with native Eng. Packets

Selected wavenumber regions

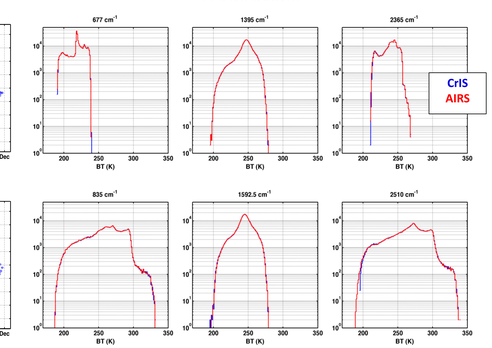
- To largely avoid issues associated with matching the CrIS and AIRS spectral properties comparisons shown here are performed for representative ~10 cm^{-1} regions, selected for sensitivity to CrIS nonlinearity and the CrIS ICT environmental model:



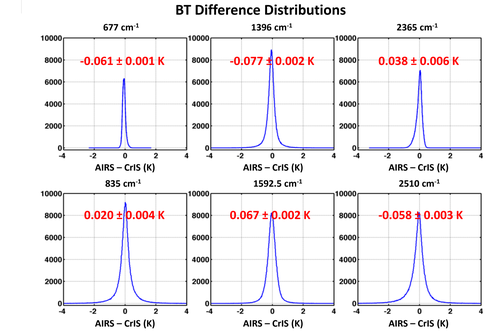
Daily Mean Differences



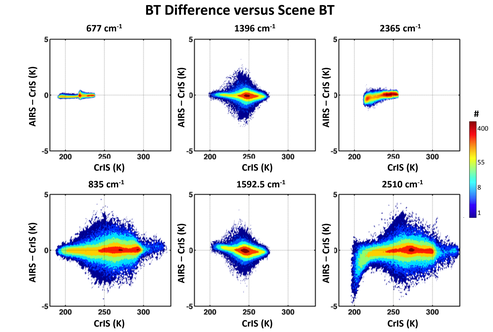
BT Distributions

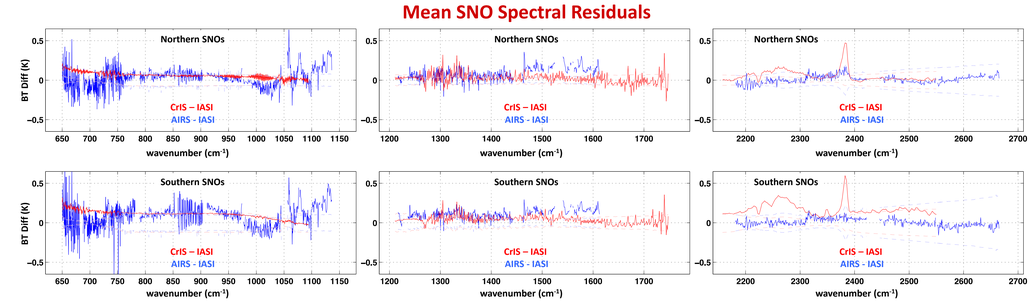


BT Difference Distributions



BT Difference versus Scene BT



CrIS/AIRS/IASI

Mean SNO Spectral Residuals