Full Spectrum Intercalibration of AIRS and CrIS

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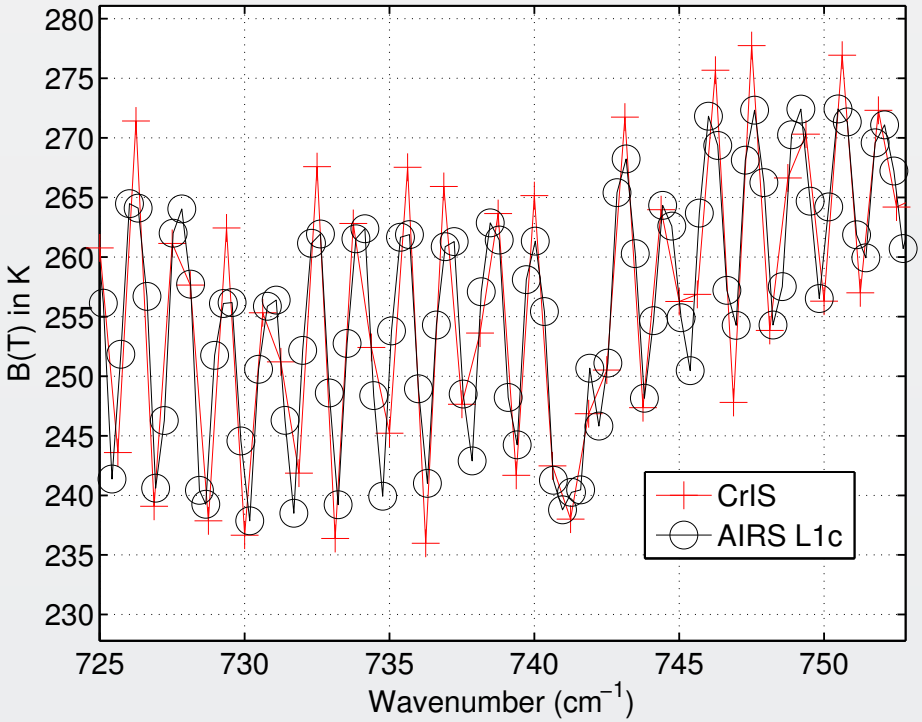
Thanks to George Aumann, Evan Manning for L1c
Sounding PEATE for SNOs.

Overview

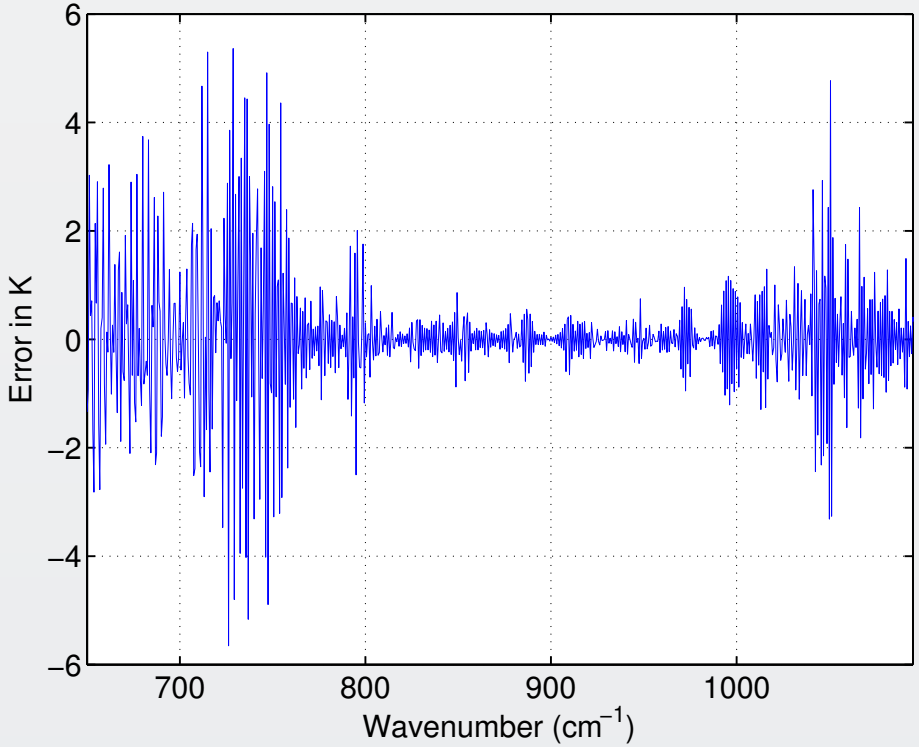
- Intercalibration of AIRS and CrIS can only be done with L1b data in winow regions.
- ILS (Instrument Line Shape) differences cause large (4+K) differences between AIRS and CrIS for
- We convert AIRS (L1c) radiances using a deconvolution, reconvolution approach.
- The AIRS⟶CrIS data may provide the best approach for building a seamless AIRS + CrIS L2 time series.

AIRS L1c: Mismatch due to ILS Differences

Sampling of AIRS vs CrIS ILS



B(T) error using just ν interpolation



CrIS ⟶ AIRS Conversion

This topic is far beyond the scope of this talk, so just a summary.

Basic methodology

S_a is a matrix of AIRS SRFs on 0.1 cm^{-1} grid.

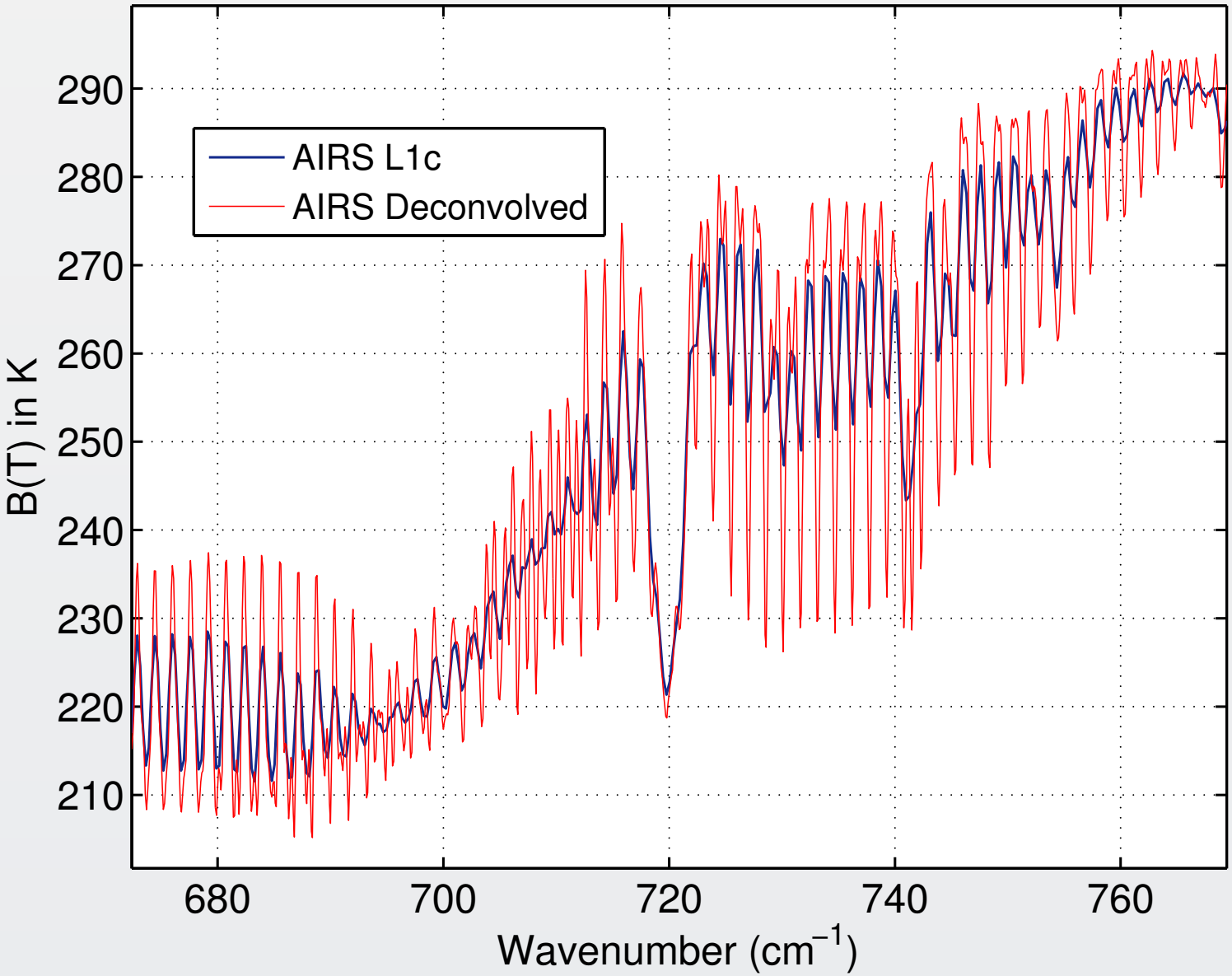
$$c = S_a r,$$

where: c = AIRS observed channel radiances, r = higher resolution representation of true radiances, on 0.1 cm^{-1} grid. (For best results, as in forward model development, we use a 0.0025 cm^{-1} spacing.) Then

$$r = (S_a)^{-1} c$$

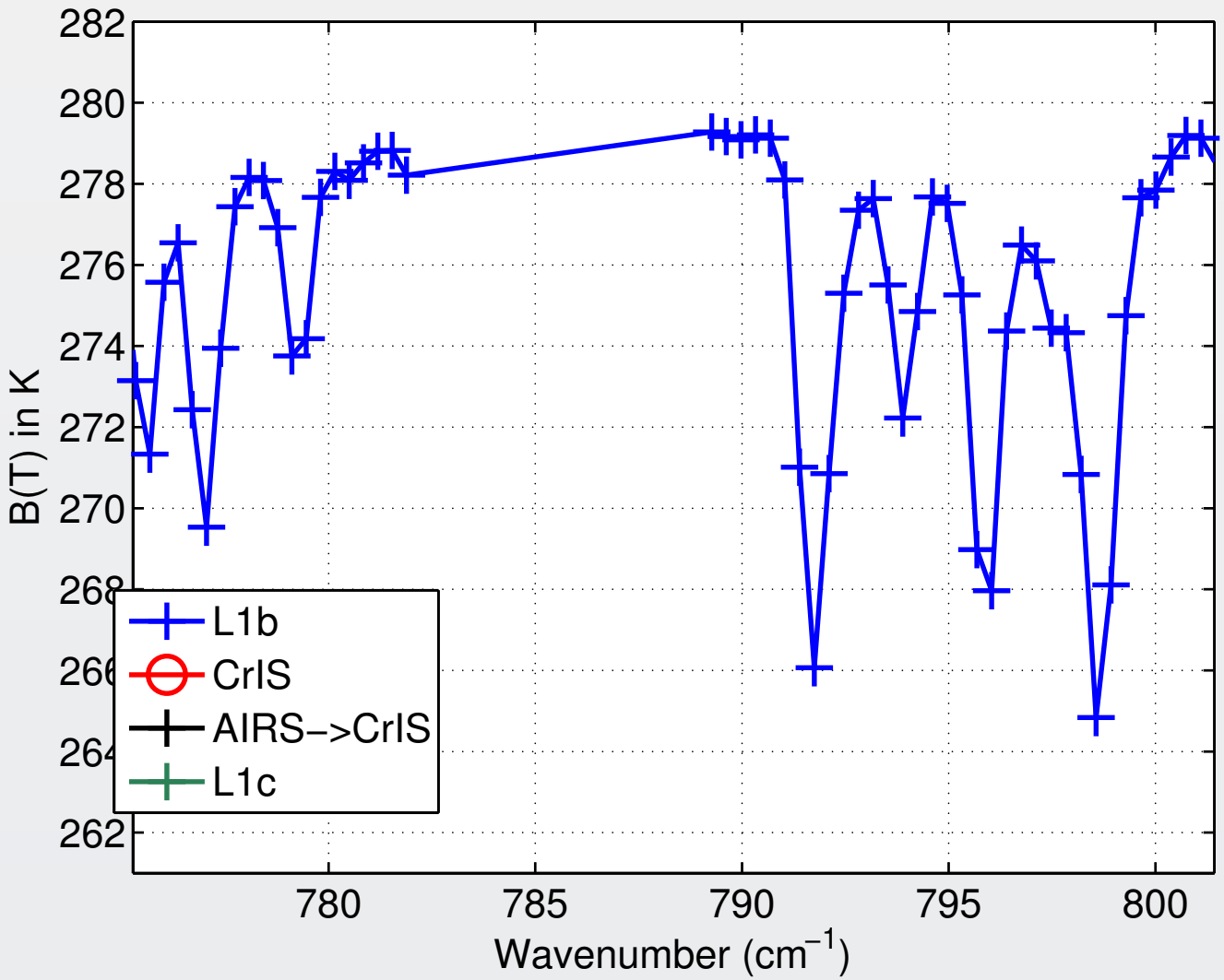
and we can obtain simulated CrIS by convolving r with the CrIS ILS. S_a condition number is very high for L1b, and drops to ≈250 for L1c if we drop four channels. The key is a uniform channel spacing.

Example of De-convolved AIRS Spectrum



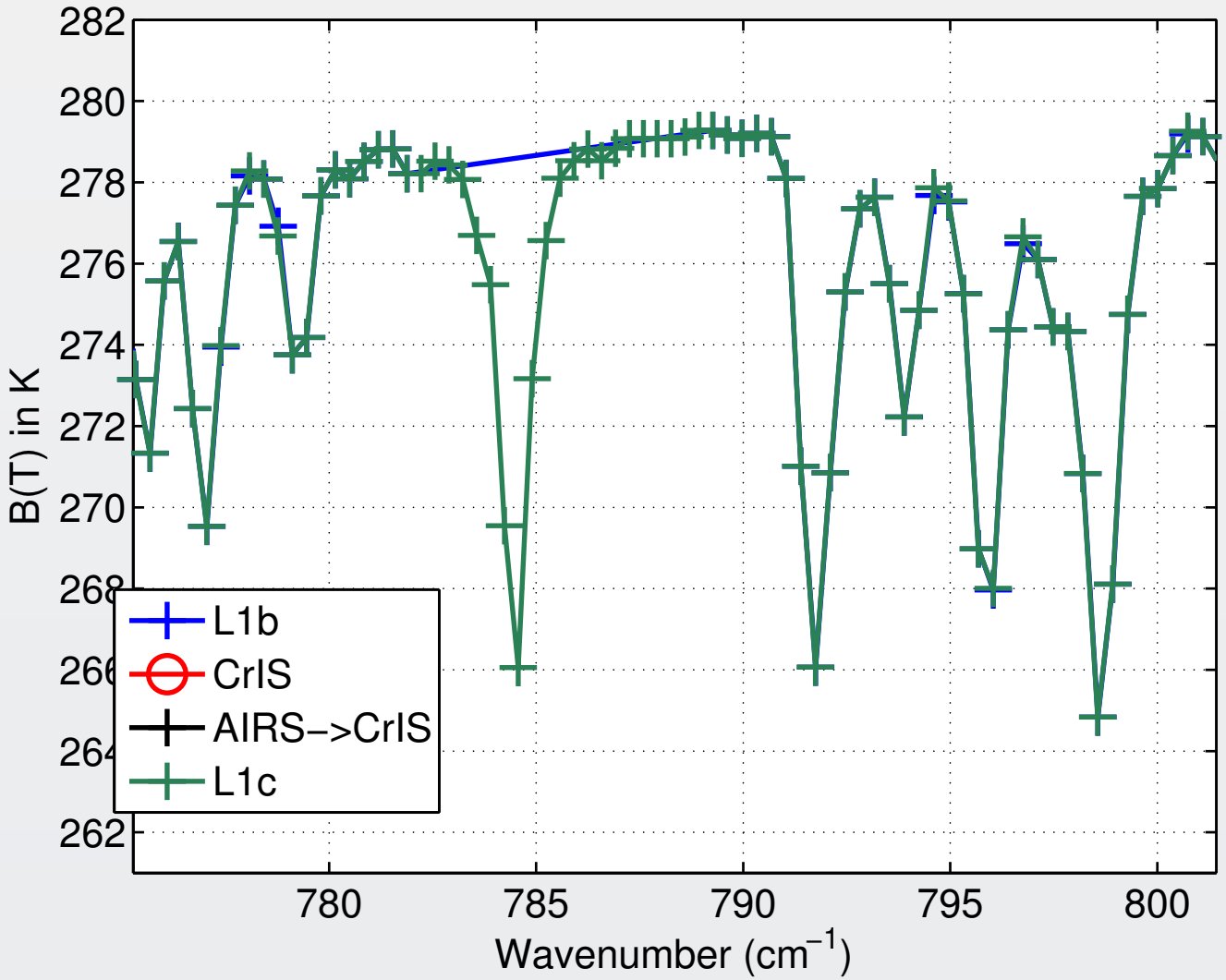
Example of AIRS L1c and Conversion to CrIS

L1b



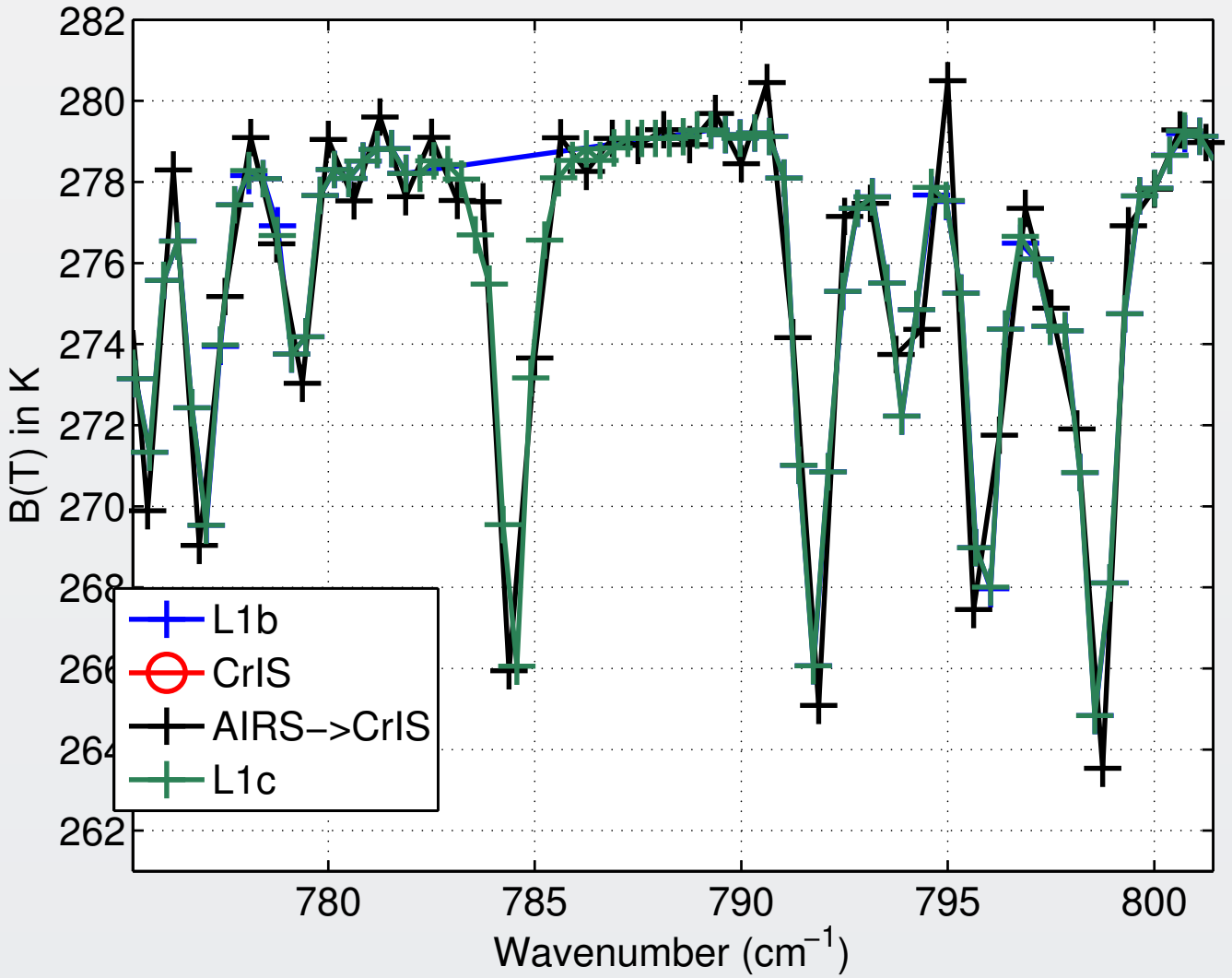
Example of AIRS L1c and Conversion to CrIS

L1b + L1c



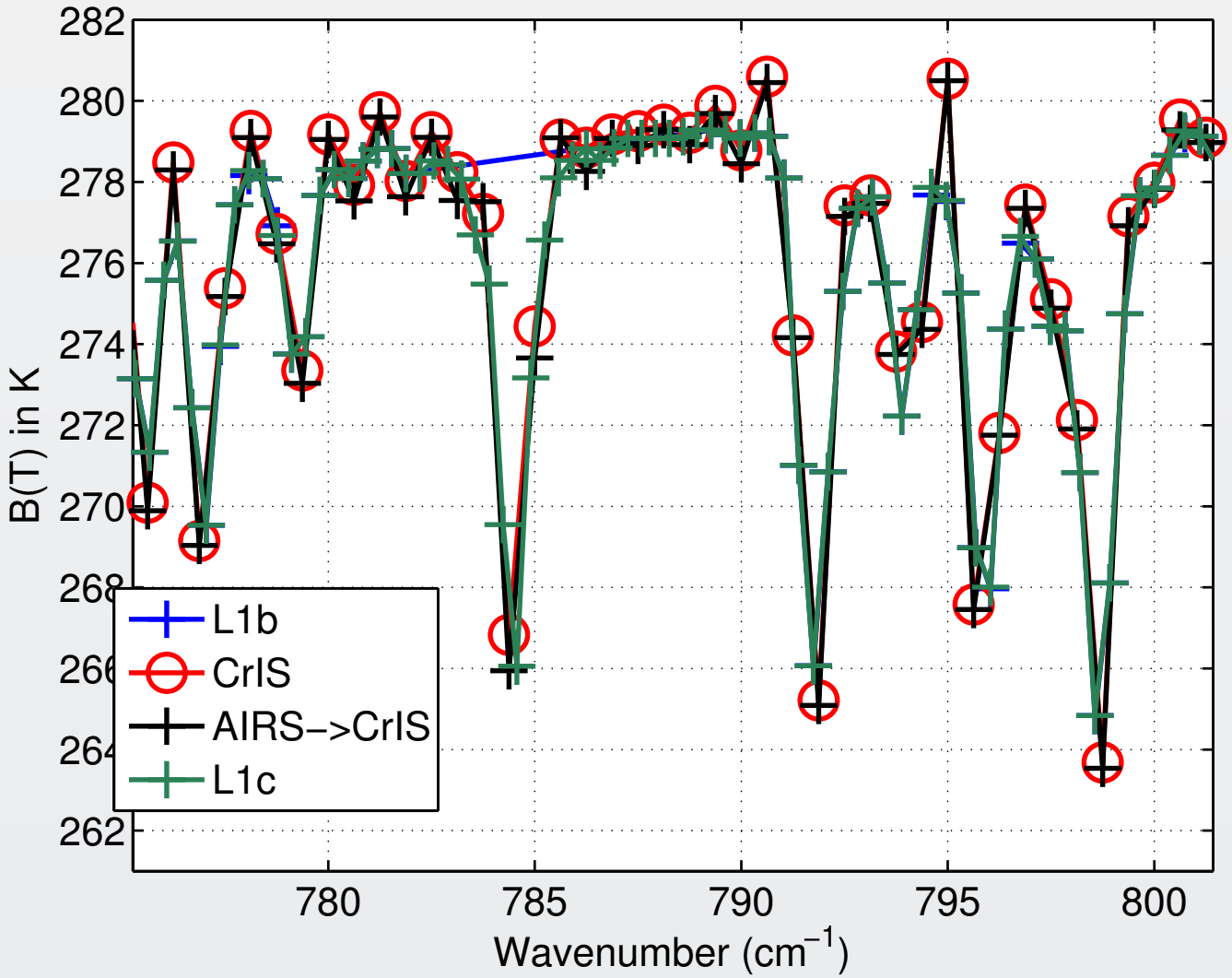
Example of AIRS L1c and Conversion to CrIS

L1b + L1c + L1c⟶CrIS



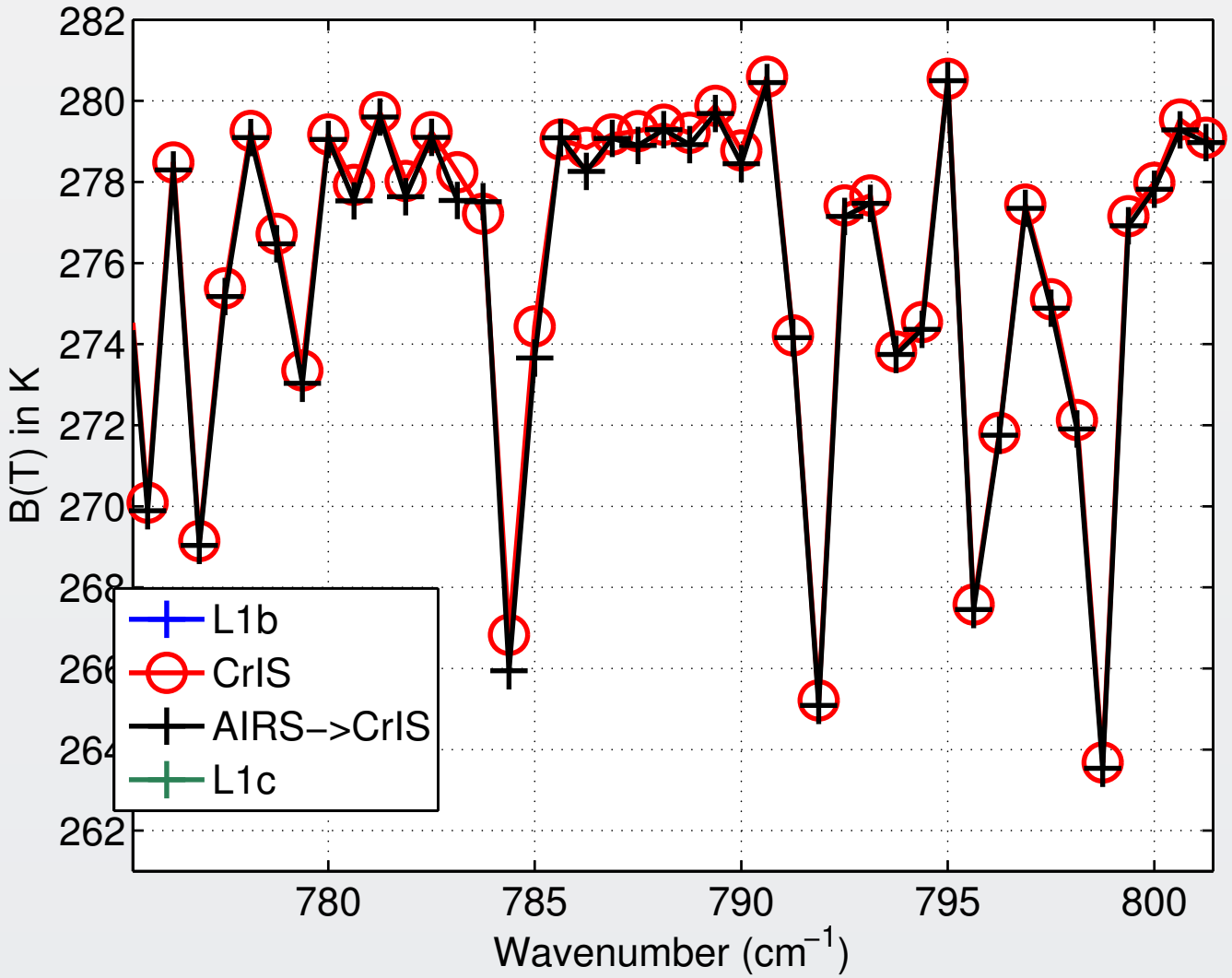
Example of AIRS L1c and Conversion to CrIS

L1b + L1c + L1c⟶CrIS + CrIS

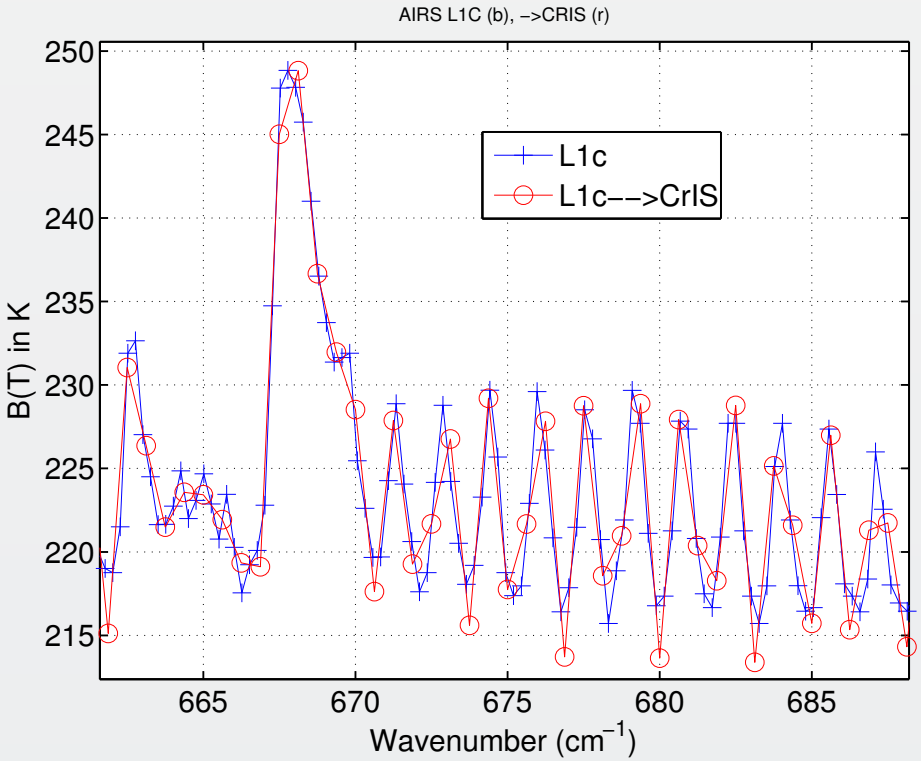


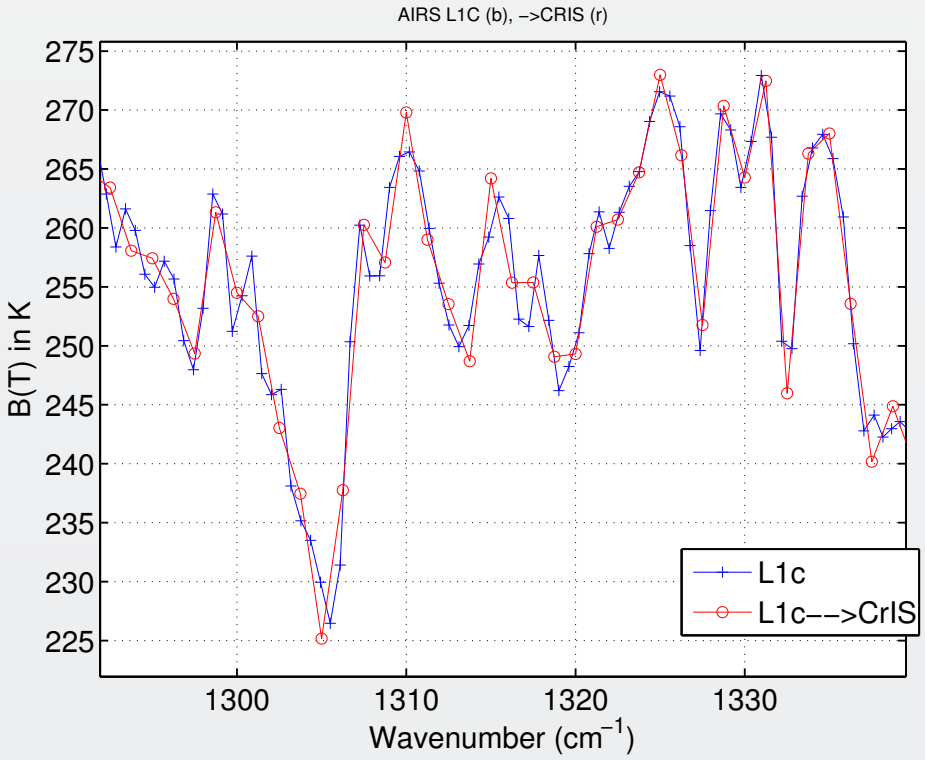
Example of AIRS L1c and Conversion to CrIS

L1c⟶CrIS + CrIS



More Comparisons: L1c with L1c->CrIS

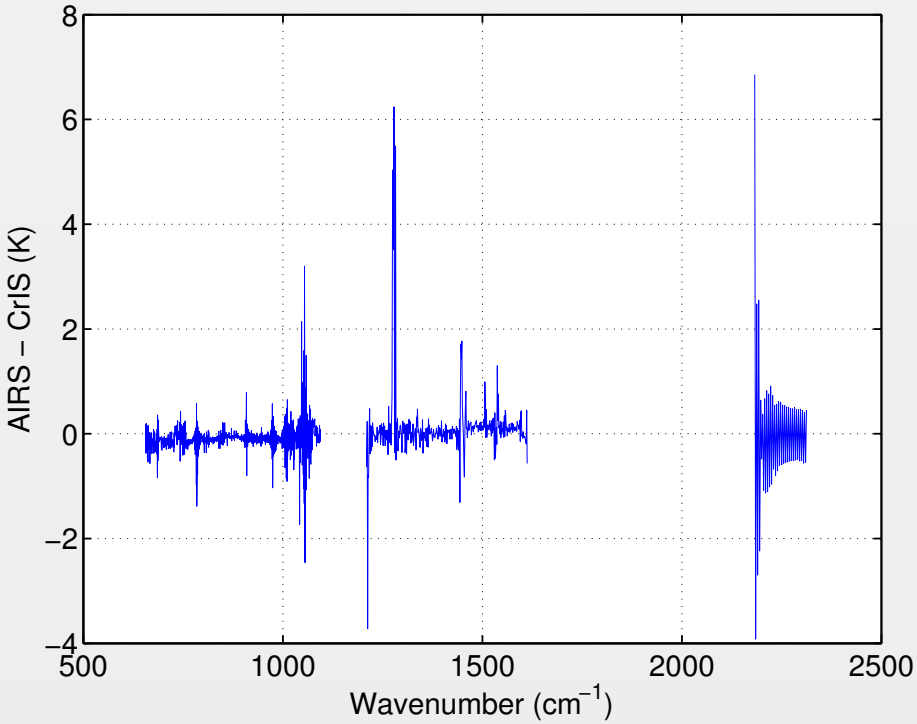




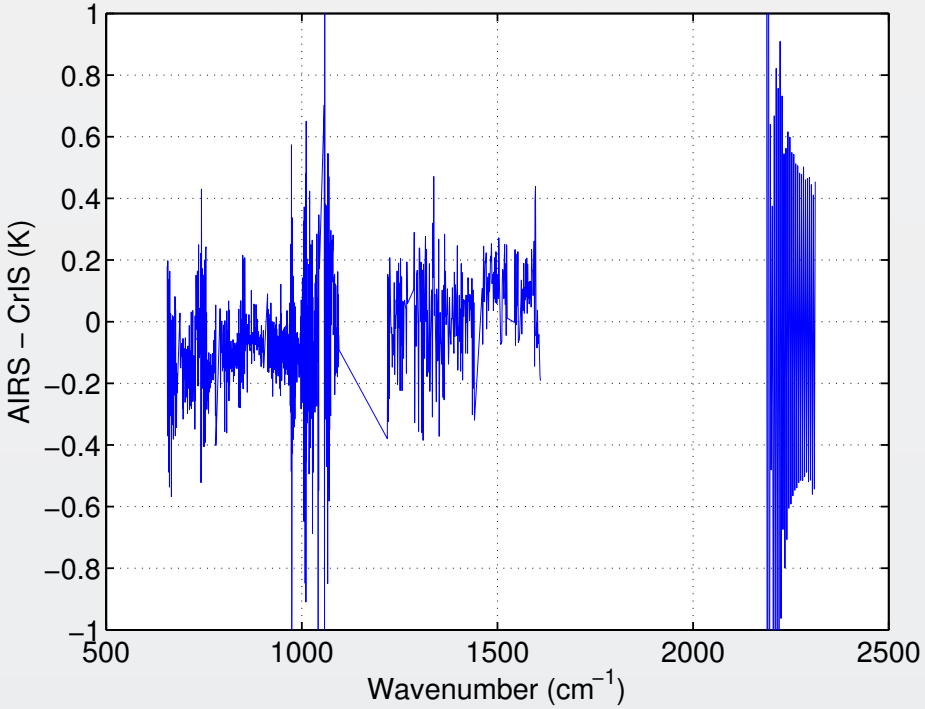
AIRS-CrIS SNOs; 1 Year Covering ± 50 Deg. Latitude

Sinc ILS Shown Here; Data Referenced to 250K B(T)

1231 No Trimming Near Band Edges



1231 Expected Good Channels



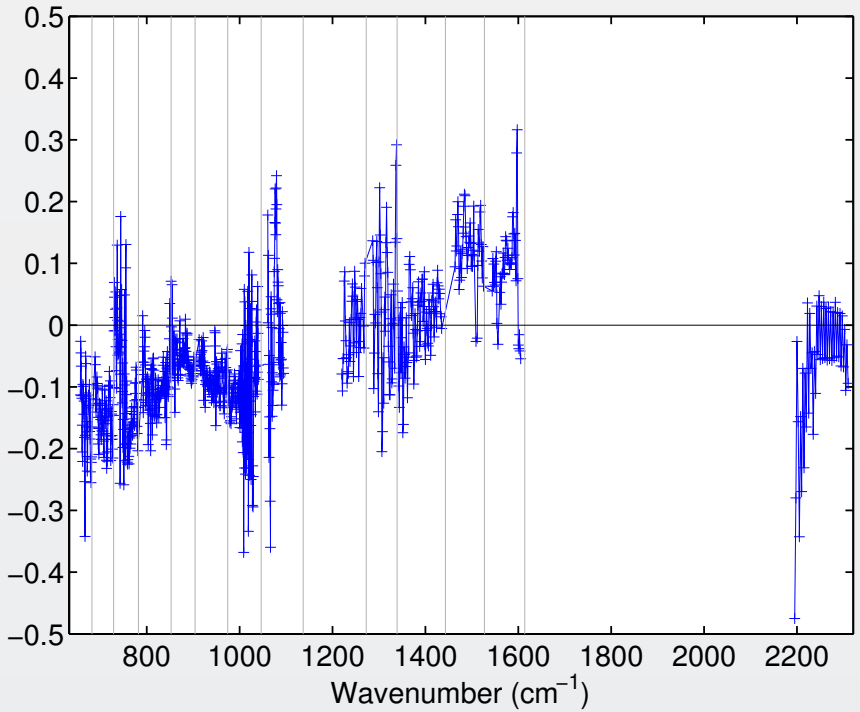
On the right hand side figure we have removed channels in AIRS gaps, near ends of AIRS arrays, or near very noisy AIRS channels.

Ringing in shortwave is probably a combination of limitation of ILS conversion algorithm and extra ringing in CrIS SDRs.

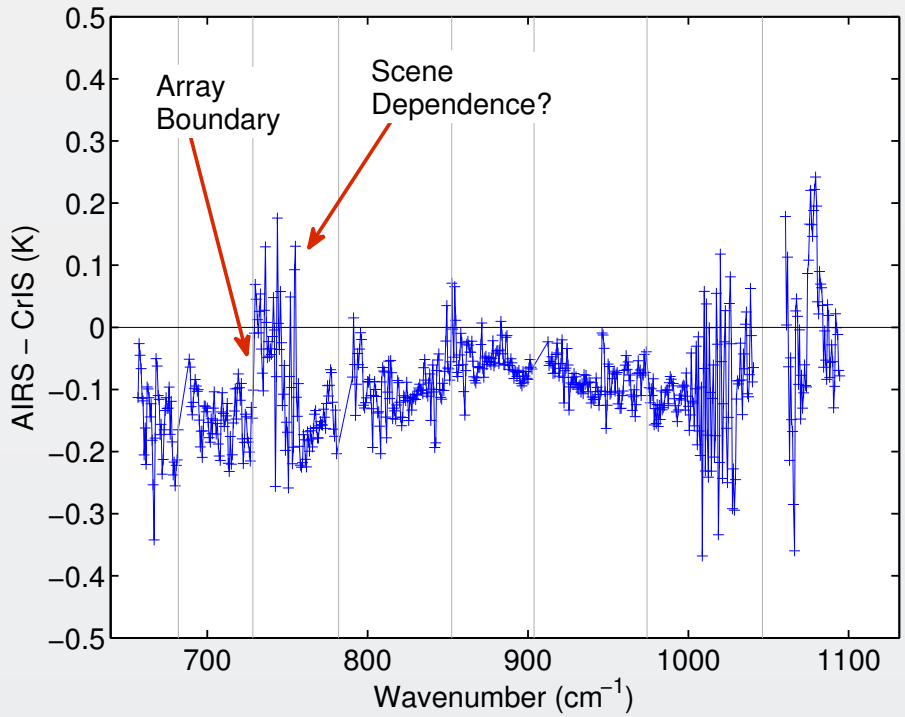
Full Spectrum Differences

Showing differences now after Hamming Apodization

Full Spectrum



Longwave Zoom

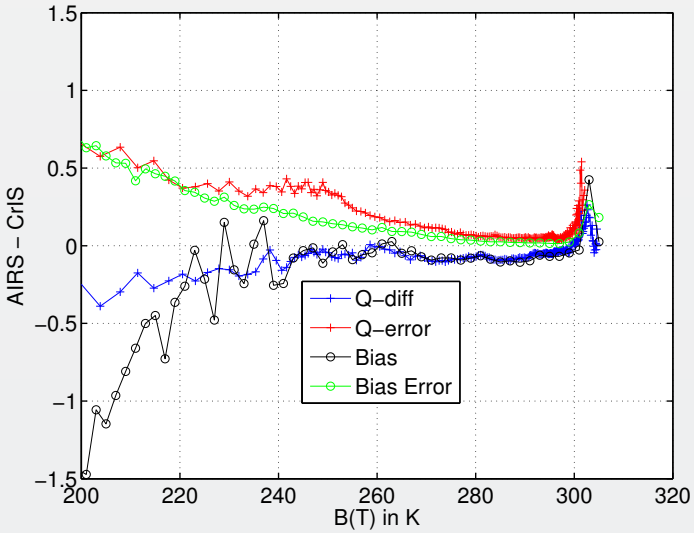


0.2K “ringing” may be due to lack of frequency calibration

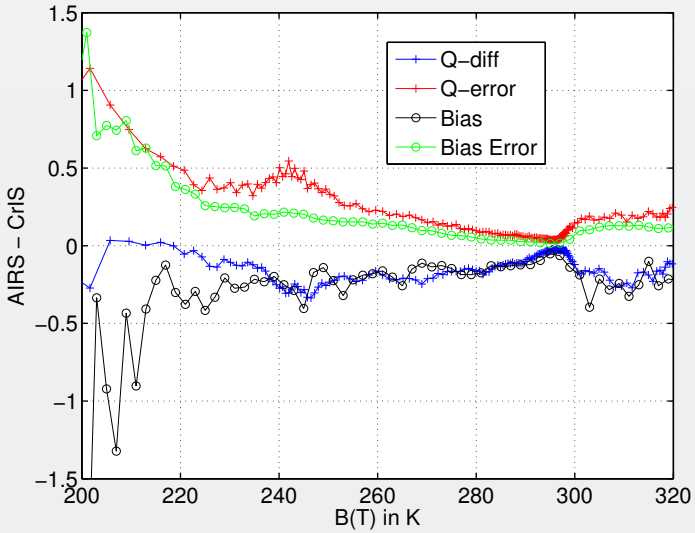
The standard error is extremely small. Day night differences are larger, esp. in the window region.

Scene Dependence of SNOs for 900 cm^{-1}

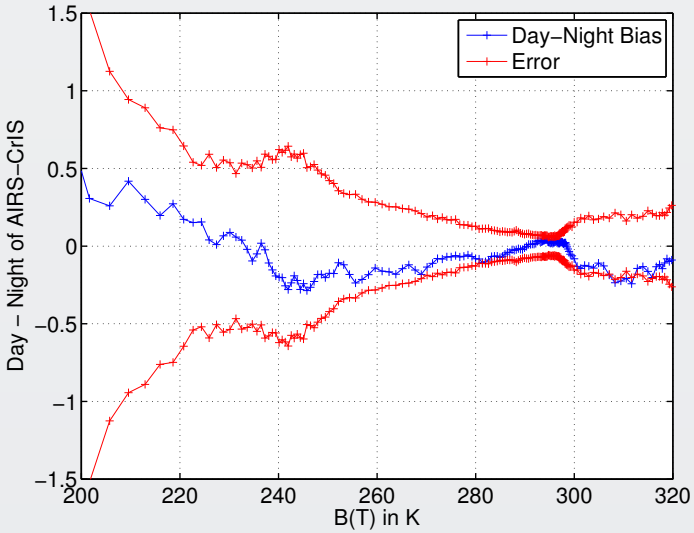
Night



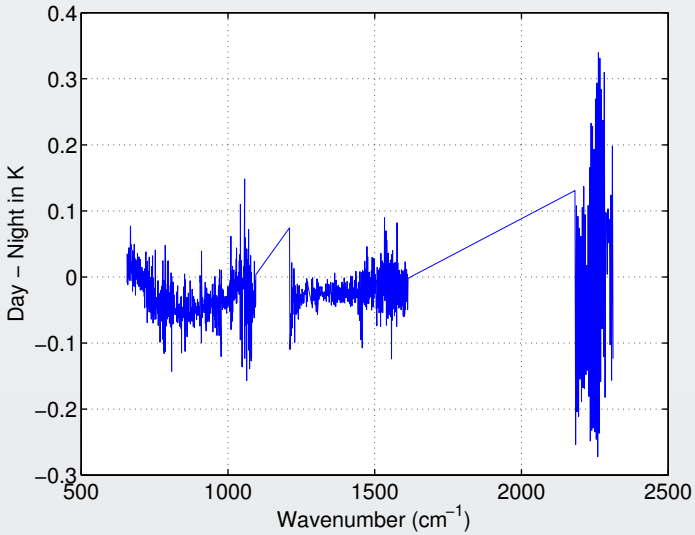
Day



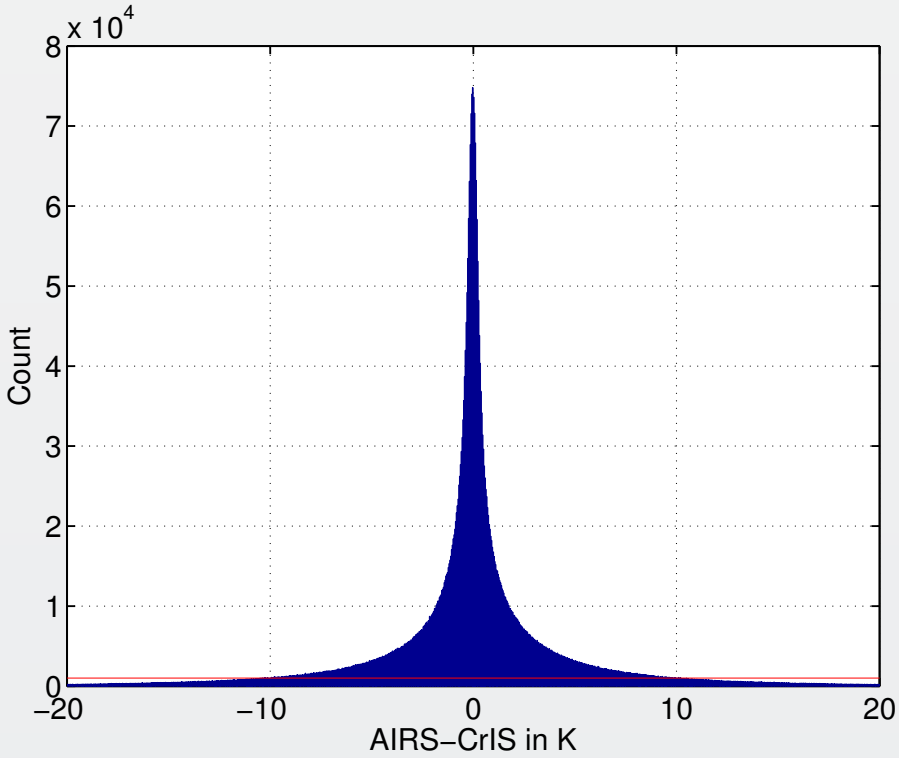
Day-Night SNO

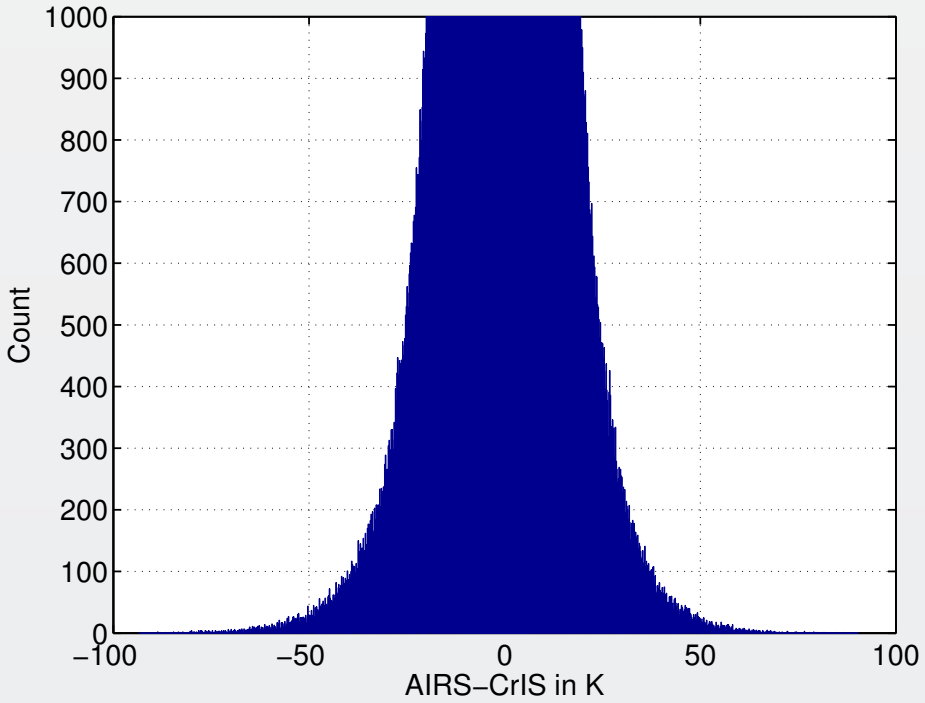


Full Spectrum



Histogram of BT 900 cm^{-1} AIRS-CrIS





Conclusions

- AIRS to CrIS ILS conversion works extremely well
- L1c is a key component of this conversion
- This allows nearly full channel comparisons of CrIS to AIRS (~1085 channels out of 1307 CrIS channels)
- Calibration intercomparisons generally within 0.2K.
- New CrIS non-linear should improve long-wave differences
- Characterization of possible scene dependent errors will require more work
- May allow seamless continuation of AIRS radiance and retrieval record once AIRS is no longer working.