CCAST and NOAA 17–19 Feb 2015 SDR Algorithm Tests

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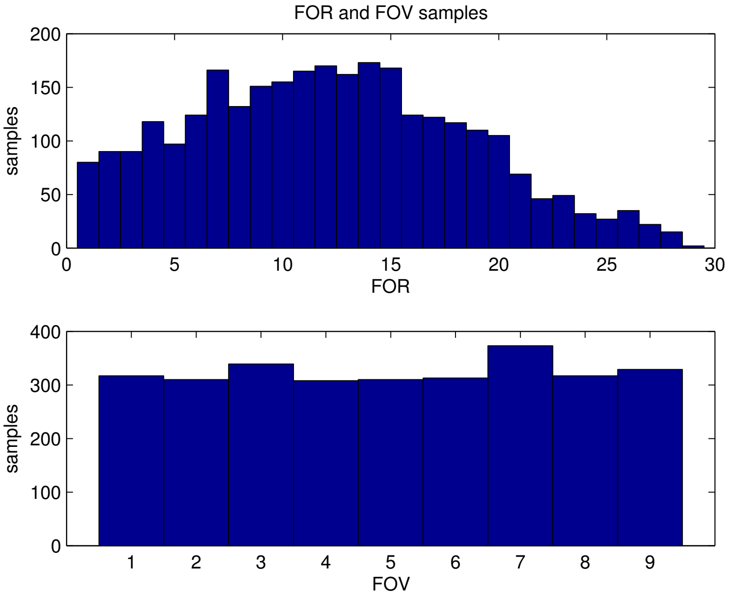
introduction

- we look at both relative and absolute comparisons of the 17–19 Feb 2015 CCAST and NOAA high res SDR test data
- although we looked at all four NOAA tests, we only show comparisons of CCAST with NOAA algorithm 4 and selected examples of algorithm 3
- supplemental slides include the CCAST calibration equation and notes on interpreting FOR as sweep differences
- CCAST SDR data from shortly after mission start is available online at asl.umbc.edu/pub/data/ccast. See readme.txt for more information and ccast_sdr.txt for the SDR format specs

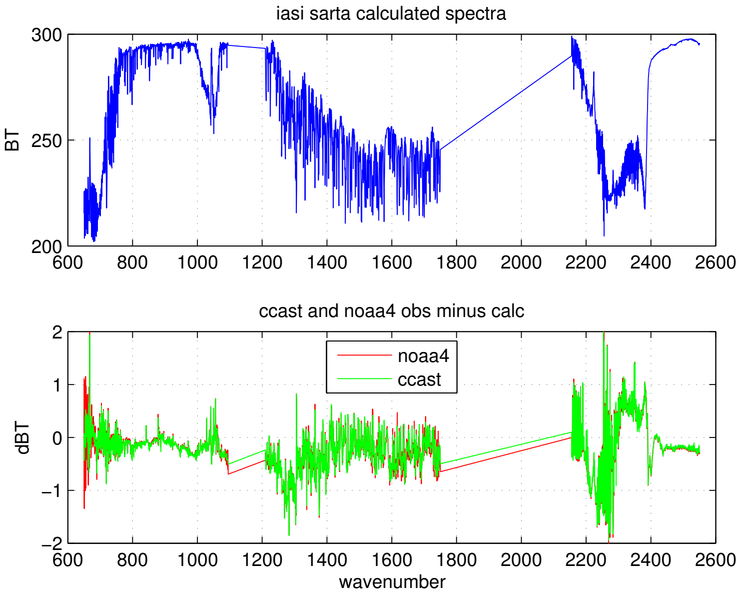
clear matchup tests

- start with 2400 clear matchups from the 17-19 Feb 2015 test data
- calculate upwelling radiances with kcarta at a 0.0025 cm-1 grid and convolve to the CrIS user grid
- calculate upwelling radiances with our IASI fast model and convolve to the CrIS user grid
- compare calculated radiances with CCAST and with NOAA algorithm 4
- the convolutions from kcarta to CrIS, IASI to CrIS, and the CrIS sensor to user grid in CCAST are all done with double Fourier interpolation, with similar procedures and filters

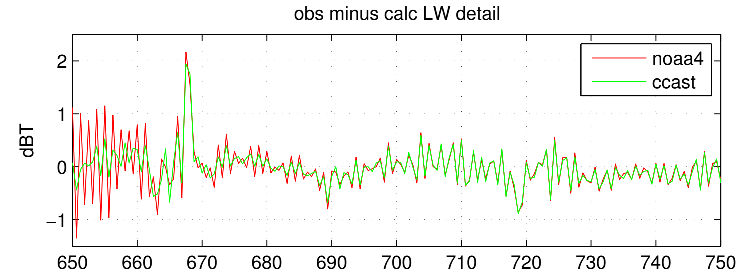
clear matchup FOV and FOR distributions

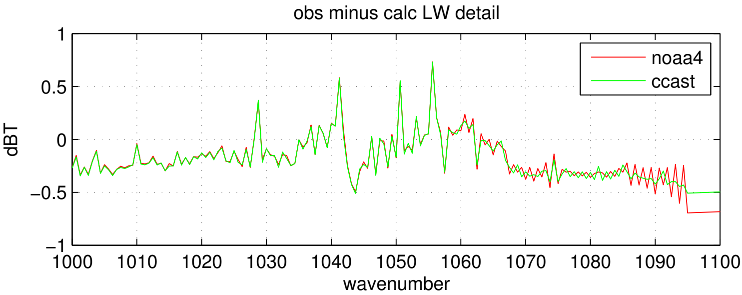


iasi sarta obs and obs minus calc



iasi sarta obs minus calc details





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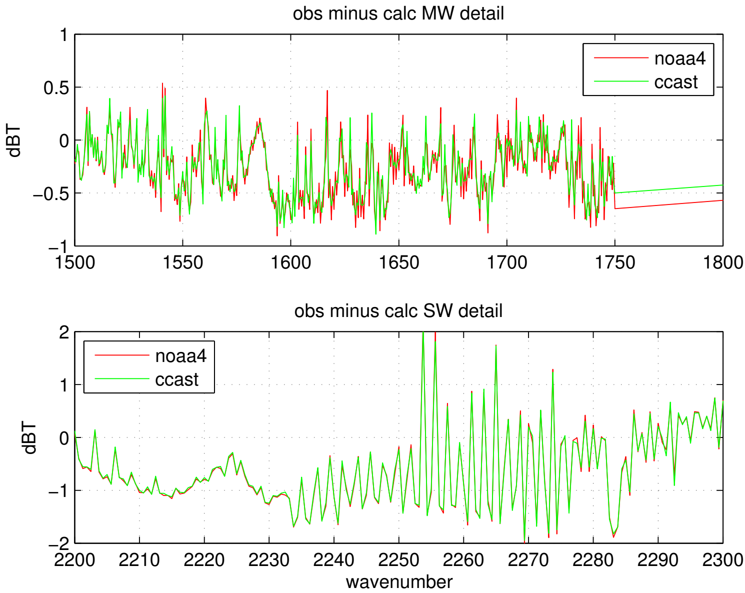
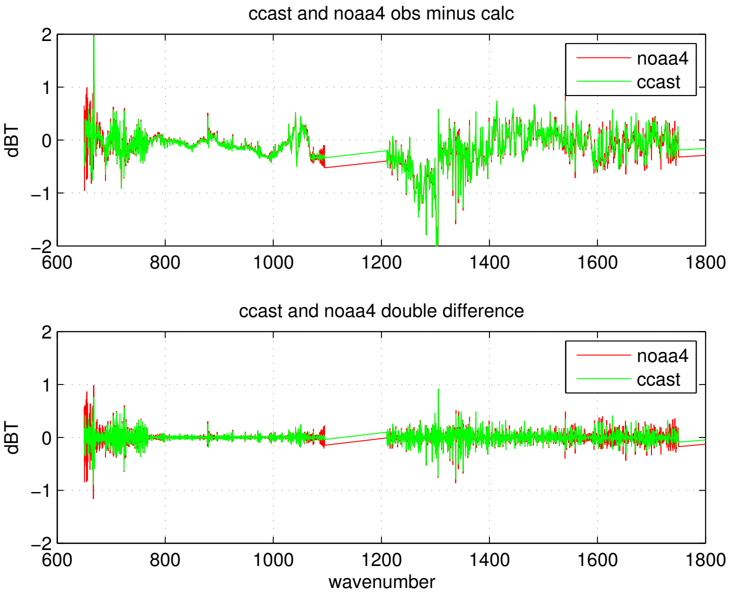
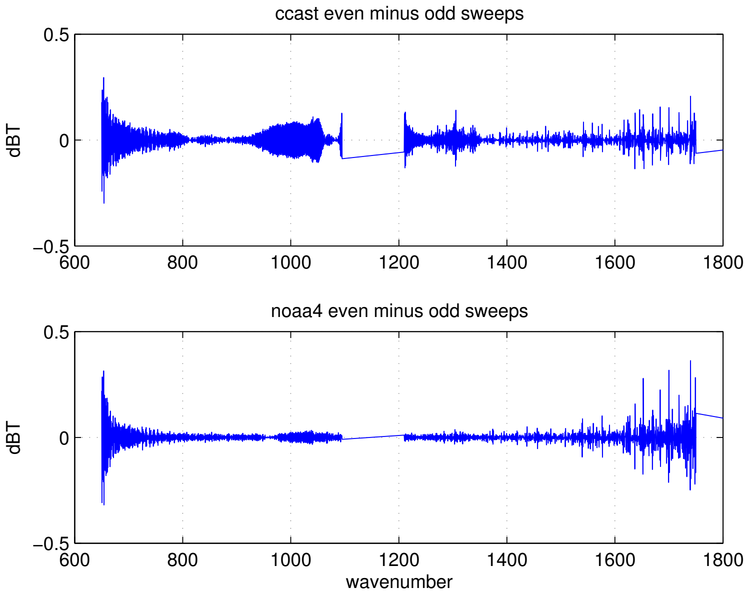


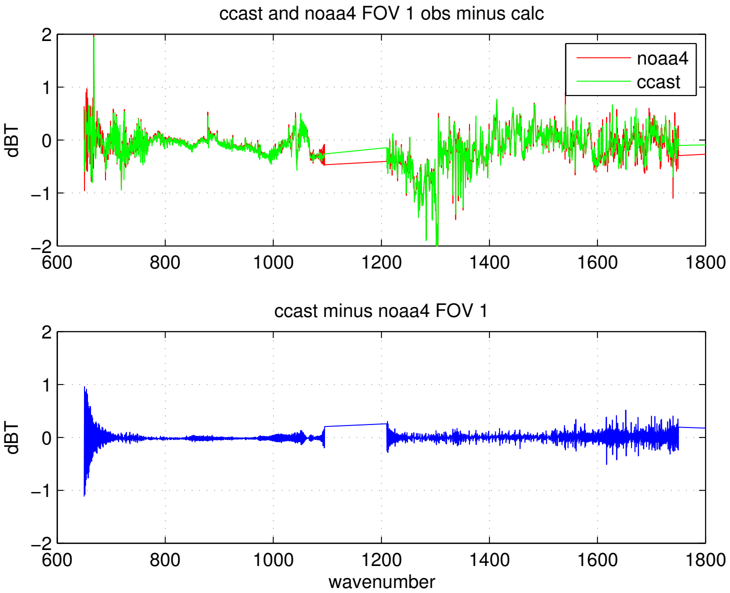
kcarta obs minus calc



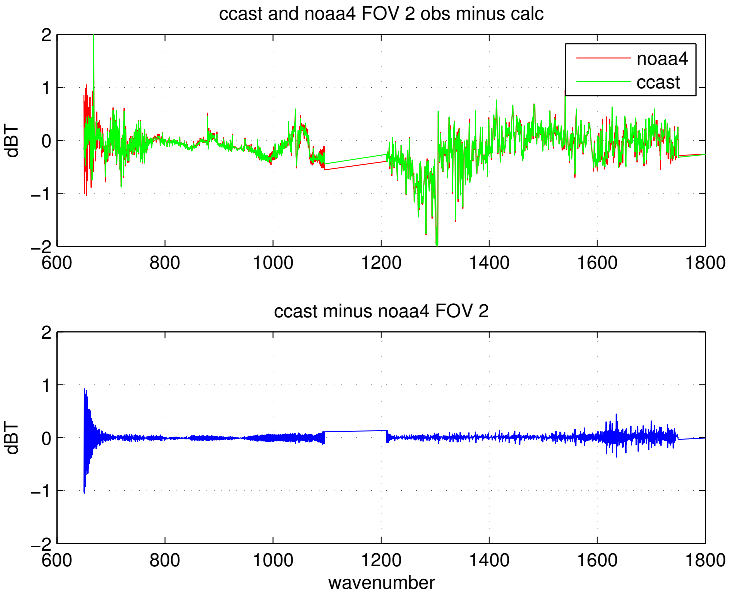
kcarta sweep differences



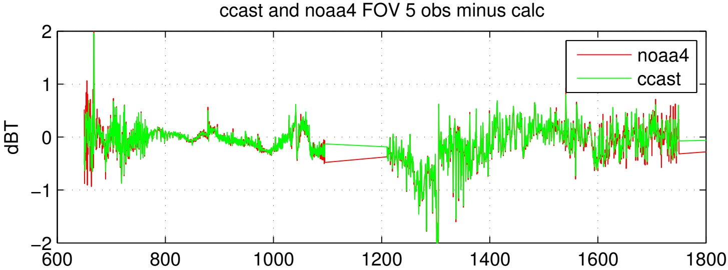
kcarta fov 1 obs minus calc

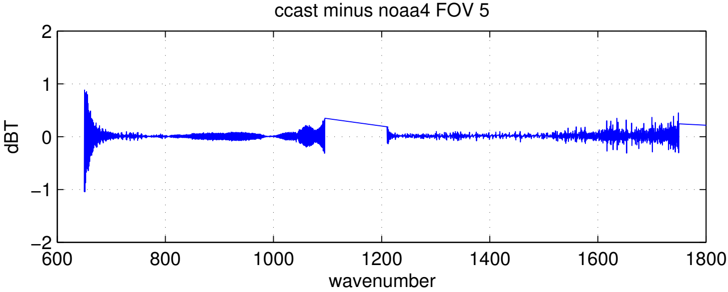


kcarta fov 2 obs minus calc



kcarta fov 5 obs minus calc





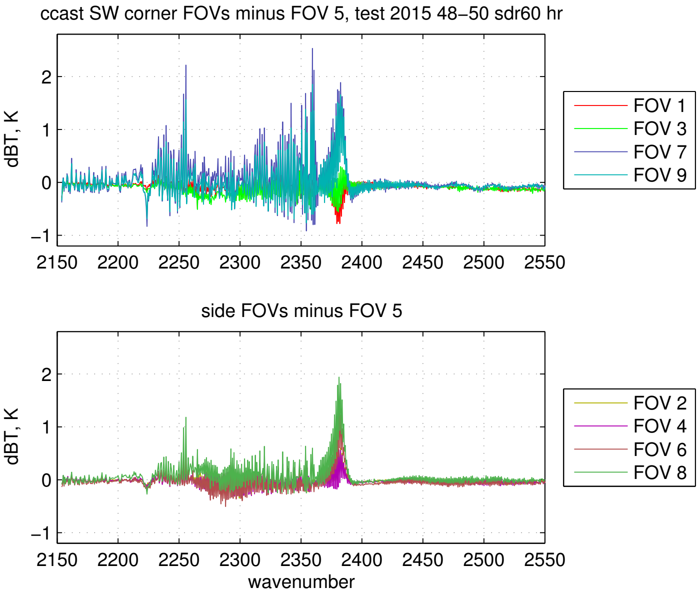
clear matchup comments

- the CCAST obs minus calc residuals were consistently smaller than NOAA algorithm 4.
- the CCAST IASI sarta residuals were much smaller at the LW band edges. Due to IASI starting at 645 cm-1, the wings of the filter used for convolving IASI to CrIS were narrower than those used for regular CCAST processing
- the NOAA algorithm 4 sweep differences were better overall, though slightly worse at the high end of the MW band
- we need to look at sweep differences broken out by FOV

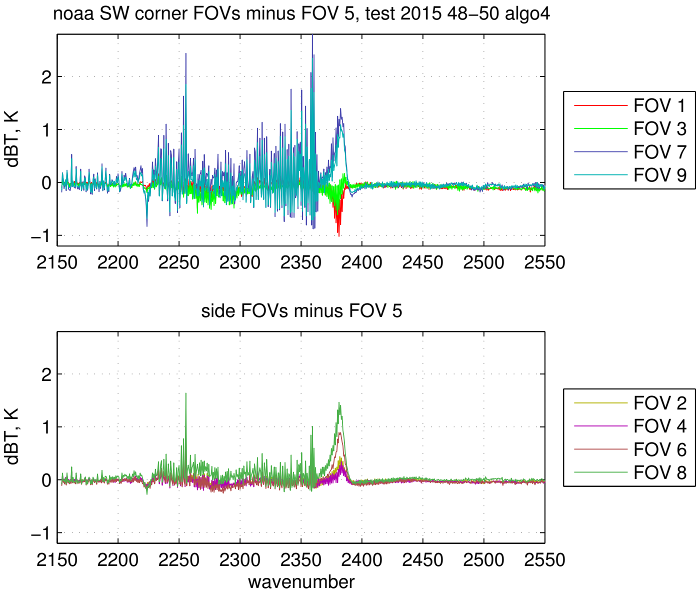
relative test methods

- start with CCAST and NOAA high res SDR data for the 17–19 Feb 2015 tests
- take the average and standard deviation of FOR 15 and 16 together over the test period for each FOV, descending only, and compare with FOV 5
- take average of FOR 15 and 16 separately over the test period for each FOV, descending only, filter to reduce scan geometry effects, and compare sweep directions
- ccast performance was similar to or better than NOAA for algorithms 1 and 2. We compare ccast with NOAA algorithm 4 and selected examples of algorithm 3

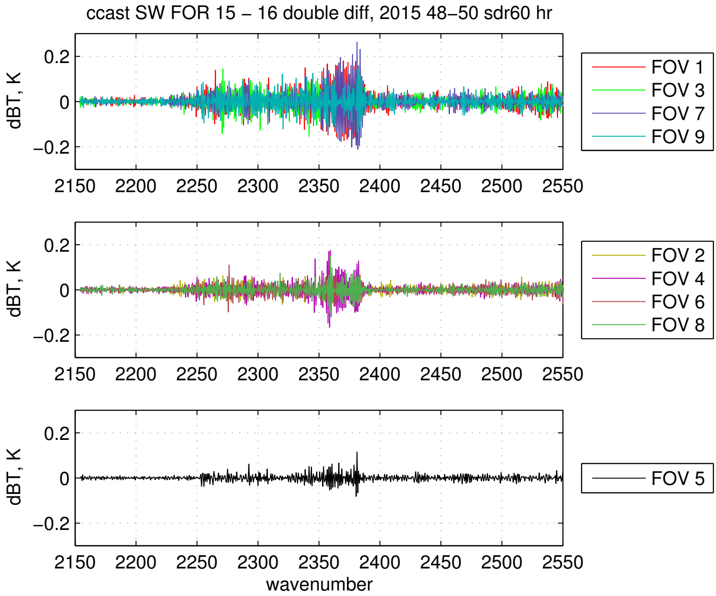
ccast sw relative to fov 5



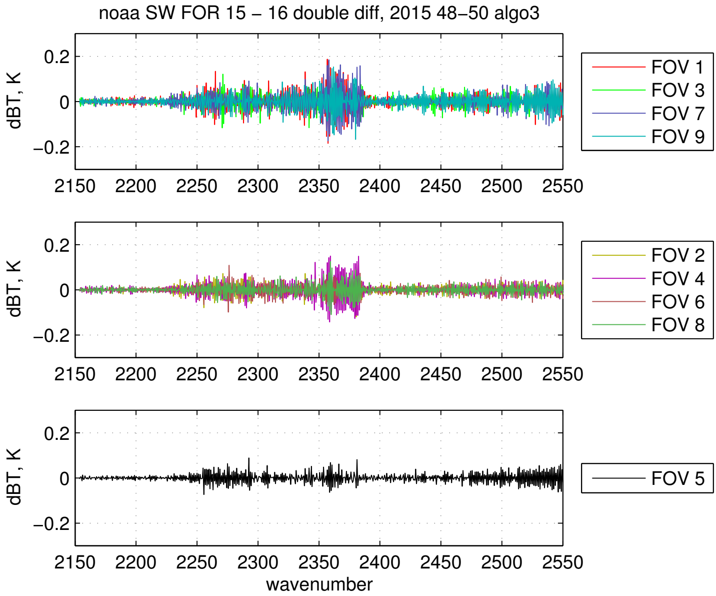
noaa 4 sw relative to fov 5



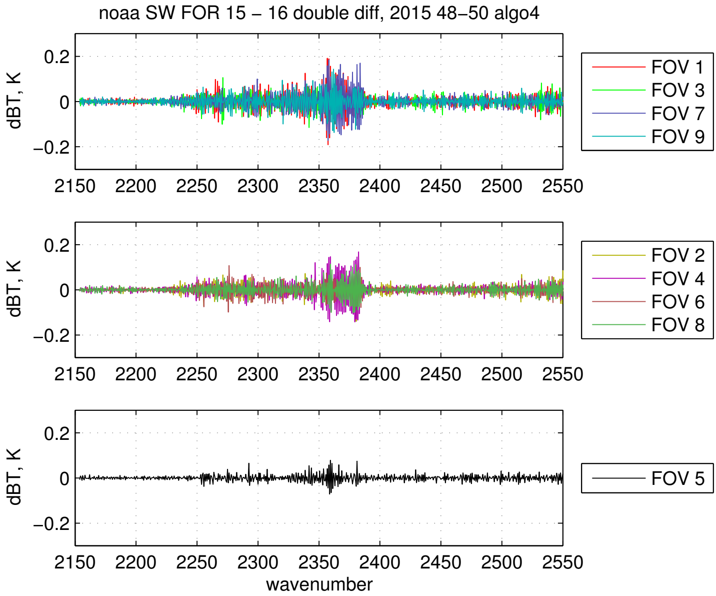
ccast sw sweep double difference



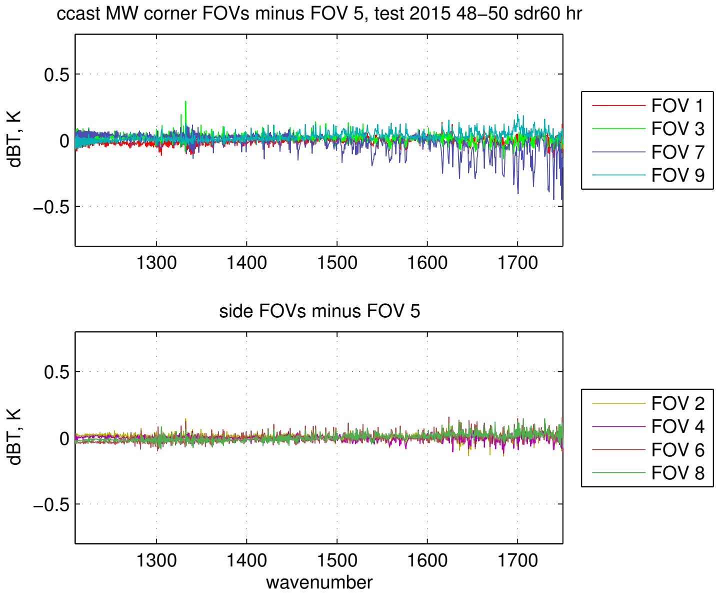
noaa 3 sw sweep double difference



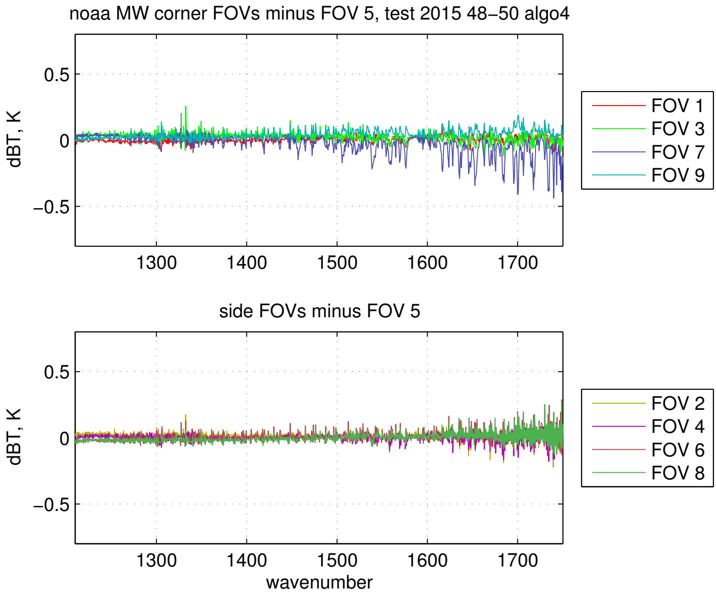
noaa 4 sw sweep double difference



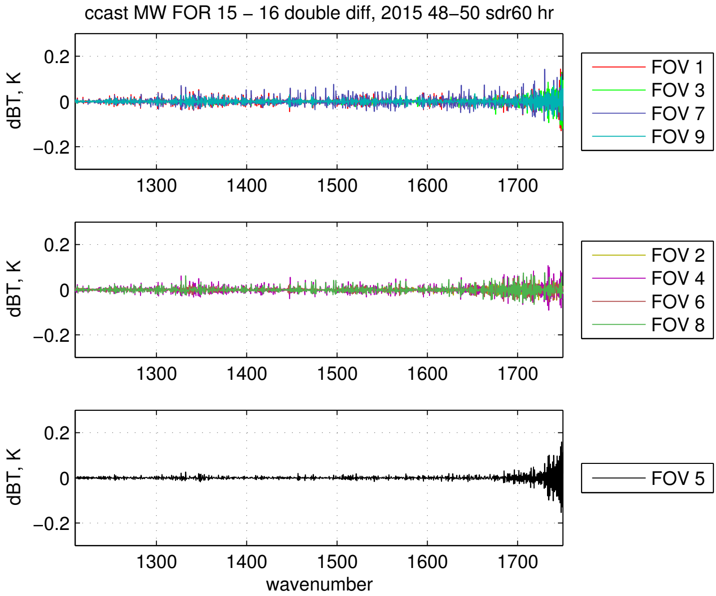
ccast mw relative to FOV 5



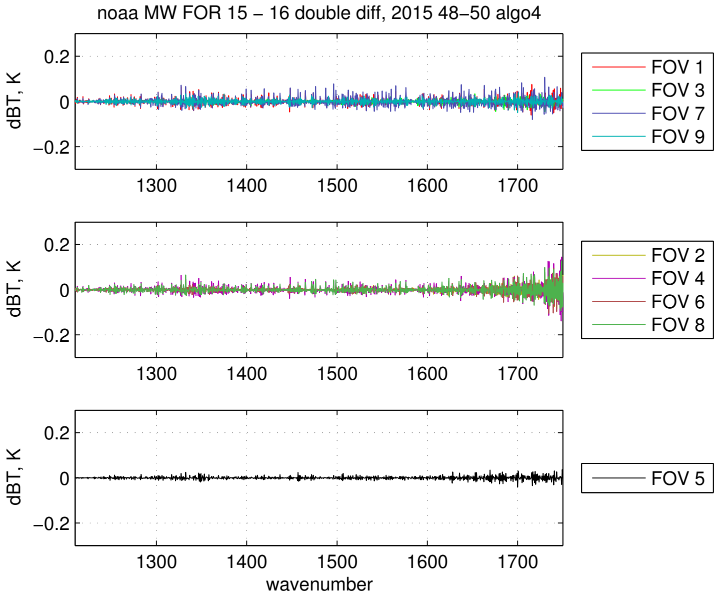
noaa 4 mw relative to fov 5



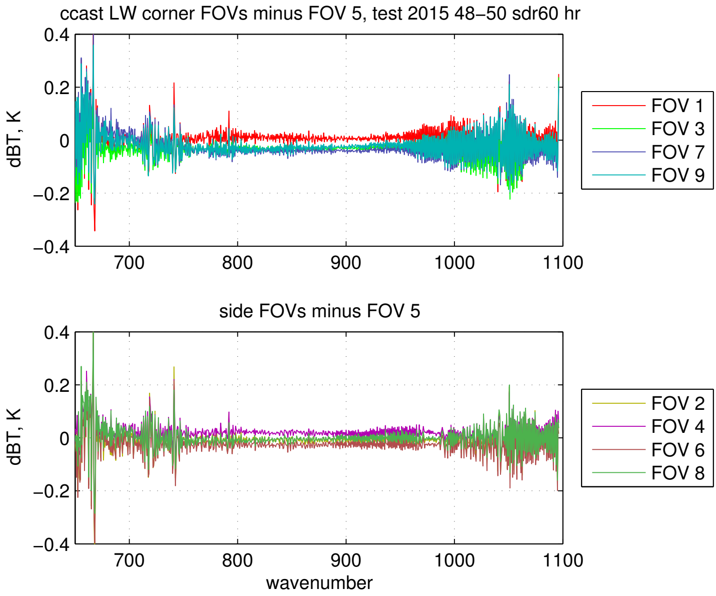
ccast mw sweep double difference



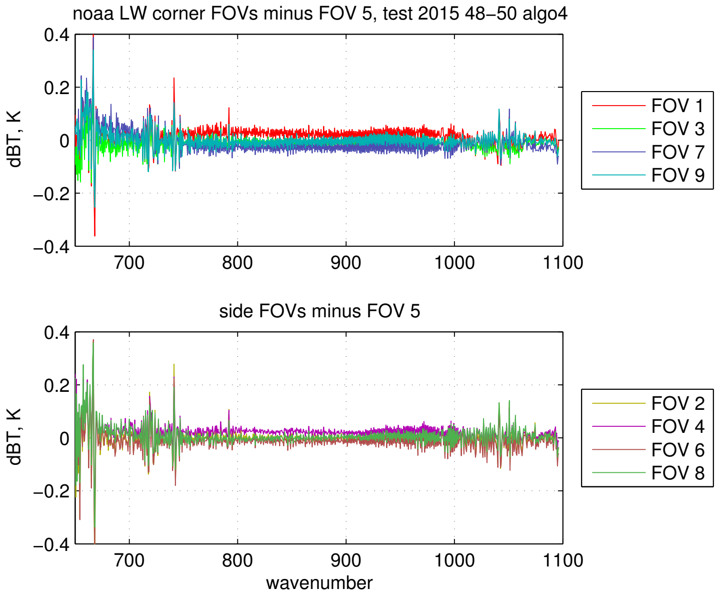
noaa 4 mw sweep double difference



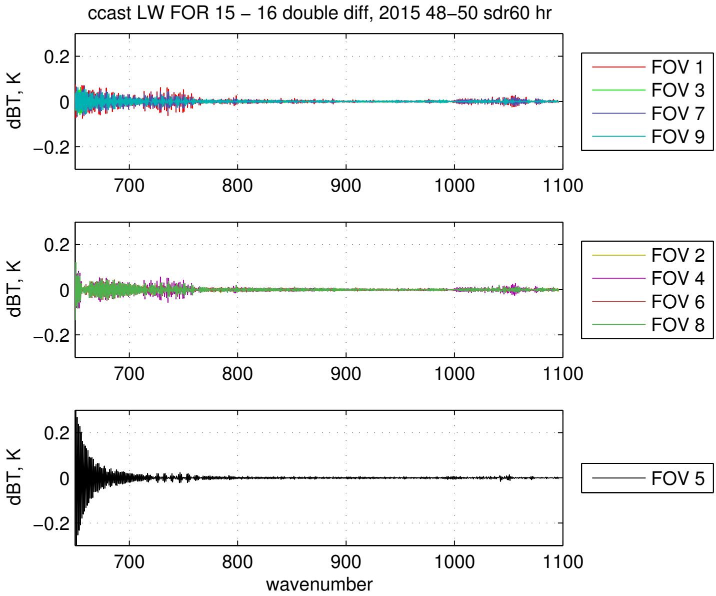
ccast lw relative to fov 5



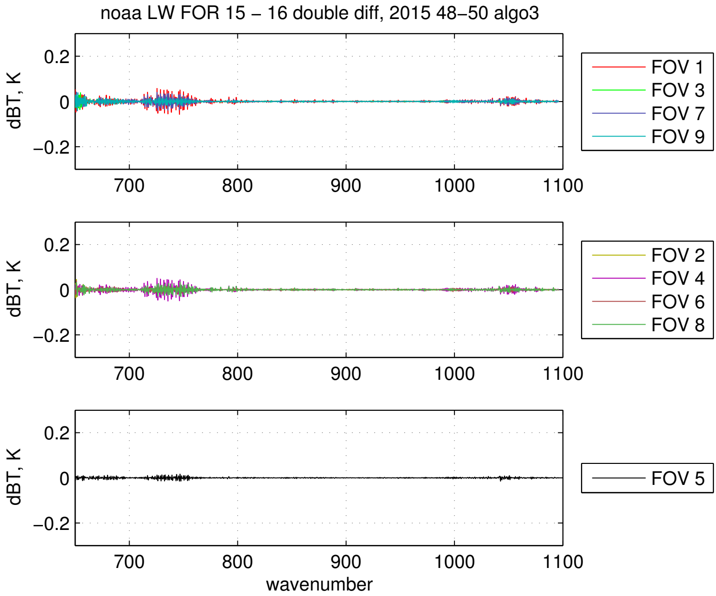
noaa 4 lw relative to fov 5



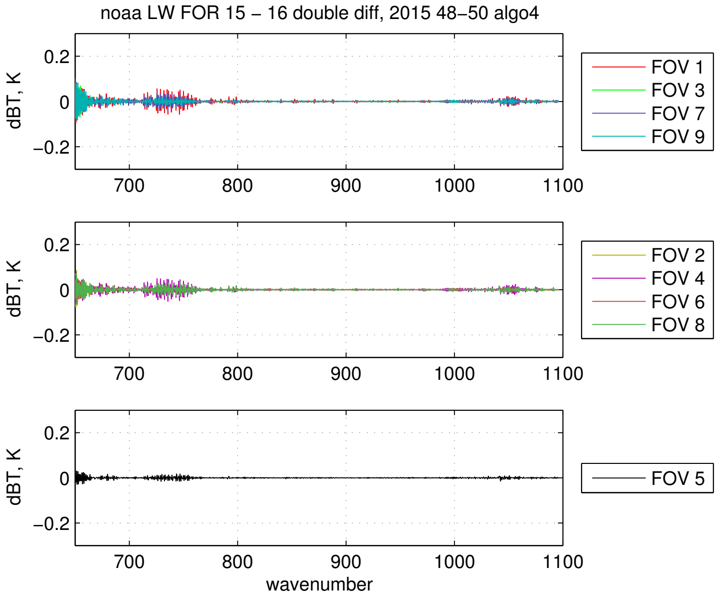
ccast lw sweep double difference



noaa 3 lw sweep double difference



noaa 4 lw sweep double difference



relative test comments

- for the SW, NOAA 3 and 4 were similar or slightly better than CCAST. For the MW results were similar, with CCAST slightly better for the FOV 5 relative test and NOAA for the sweep differences
- for the LW, NOAA 3 and 4 were significantly better than CCAST. CCAST was similar to NOAA 1 and 2, which we do not show here. The CCAST FOV 5 sweep difference was unexpectedly large in comparison with other FOVs and the NOAA differences
- the performance of CCAST in the relative tests—in particular for the LW—may be due in part to FOV 5 being slightly out of group
- the CCAST LW residuals were largely uneffected by changes in the bandpass or from periodic to regular sinc. The LW sweep difference persisted even when the SA correction was dropped

ccast calibration equation

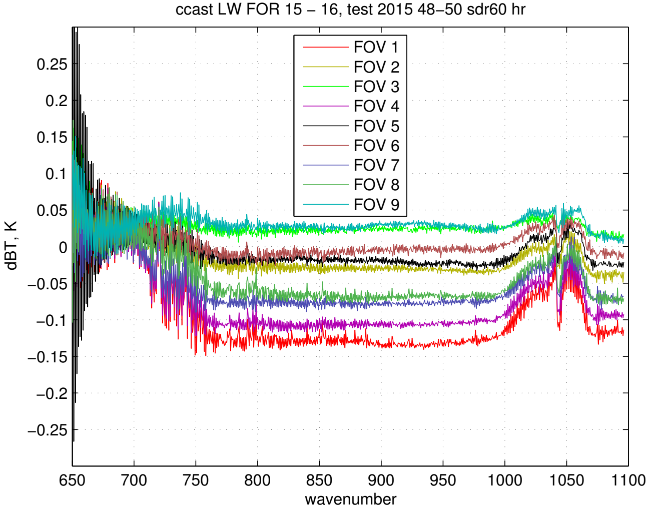
$$r_{\mathrm{ES}} = F \cdot r_{\mathrm{ICT}} \cdot f \cdot \mathsf{SA}^{-1} \cdot f \cdot \frac{\mathsf{ES} - \langle \mathsf{SP} \rangle}{\langle \mathsf{IT} \rangle - \langle \mathsf{SP} \rangle}$$

- r_{ES} is calibrated earth-scene radiance at the user grid
- F is Fourier interpolation from sensor to user grid
- r_{ICT} is expected ICT radiance at the sensor grid
- f is a raised-cosine bandpass filter with wings at or just inside instrument responsivity
- SA is from a periodic sinc ILS wrapping at the sensor grid
- ES, $\langle \mathsf{IT} \rangle$ and $\langle \mathsf{SP} \rangle$ are corrected for nonlinearity
- $\langle \mathsf{IT} \rangle$ and $\langle \mathsf{SP} \rangle$ are averages over 9 scans

sweep differences

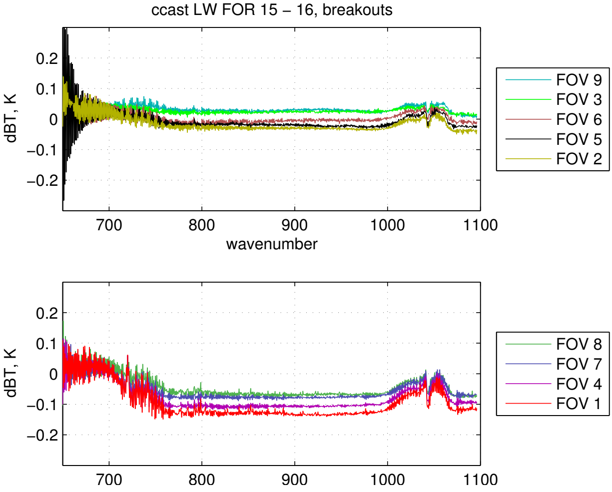
- some caution is needed in interpreting FOR as sweep differences, because the scan geometery is not identical
- to separate these effects we use a 7-point Gaussian moving average to smooth FOR differences, and take the unsmoothed minus the smoothed differences. This acts as a high-pass filter
- we use this double difference, broken out by side, corner, and center FOVs to compare sweep direction differences.
- the following four slides compare regular and double FOR differences

sweep differences



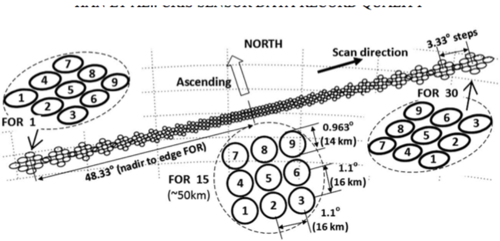
ccast LW FOR 15 minus FOR 16, for the three-day test

sweep differences



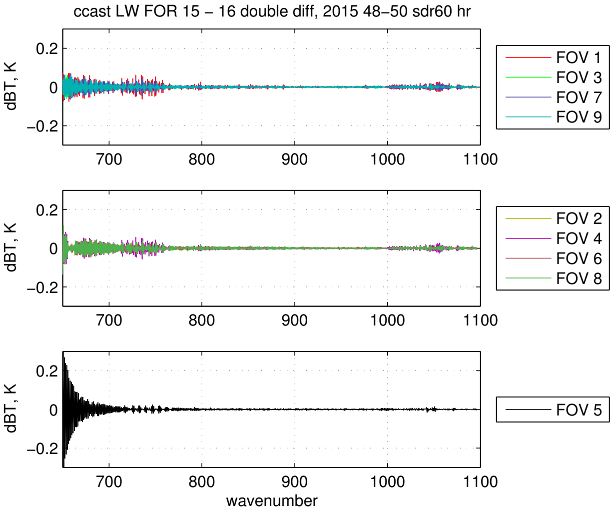
breakout of differences ordered by mid-band value

sweep differences



CrIS near-nadir FOR positions from the ATBD. Note that the two FOV groups [9, 3, 6, 5, 2] and [8, 7, 4, 1] from the previous slide approximately bisect this pattern

double difference



(FOR 15 minus 16) minus convolved (FOR 15 minus 16)