

CrIS TVAC PFH Gas Cell Tests

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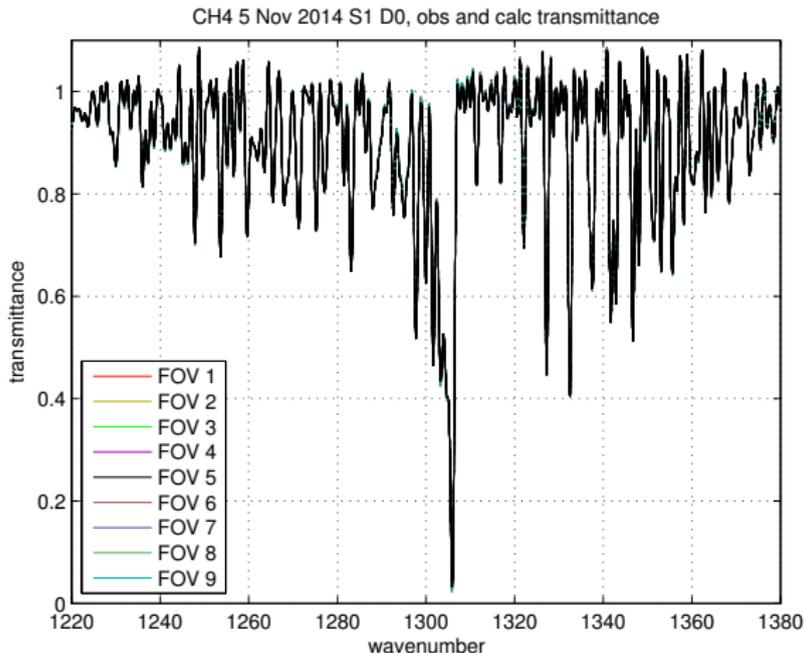
overview

- ▶ in general the CH_4 , NH_3 , and CO_2 PFH tests show good agreement with calculated transmittances
- ▶ residuals for the CH_4 and NH_3 PFH side 1 tests have small low-frequency components that we did not notice in earlier tests
- ▶ there was a significant difference between nominal and observed NH_3 pressure
- ▶ a comparison of absolute metrology laser residuals across all tests shows generally good agreement, with the exception of those NH_3 tests where the nominal and observed pressures were different

CH₄ test parameters

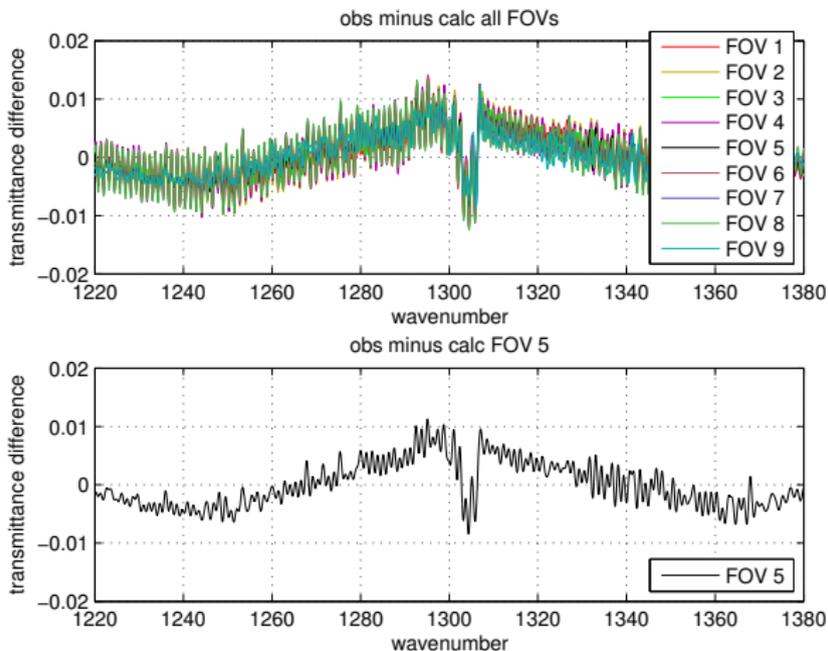
- ▶ MW PFH, 5-6 Nov 2014
- ▶ side 1, sweep direction 0
- ▶ fitting interval 1220 to 1380 cm⁻¹
- ▶ metrology laser 775.3786 nm from neon cal
- ▶ Oct 2013 Exelis side 1 focal plane values
- ▶ ILS with periodic sinc wrap at the sensor grid
- ▶ HTBB nominal T1 360 K, T2 320 K
- ▶ 330 observations in each test leg
- ▶ gas cell nominal pressure 40.6 torr
- ▶ gas cell observed pressure 40.6 torr
- ▶ gas cell temperature 17.6 C
- ▶ gas cell length 12.59 cm

CH₄ obs and calc



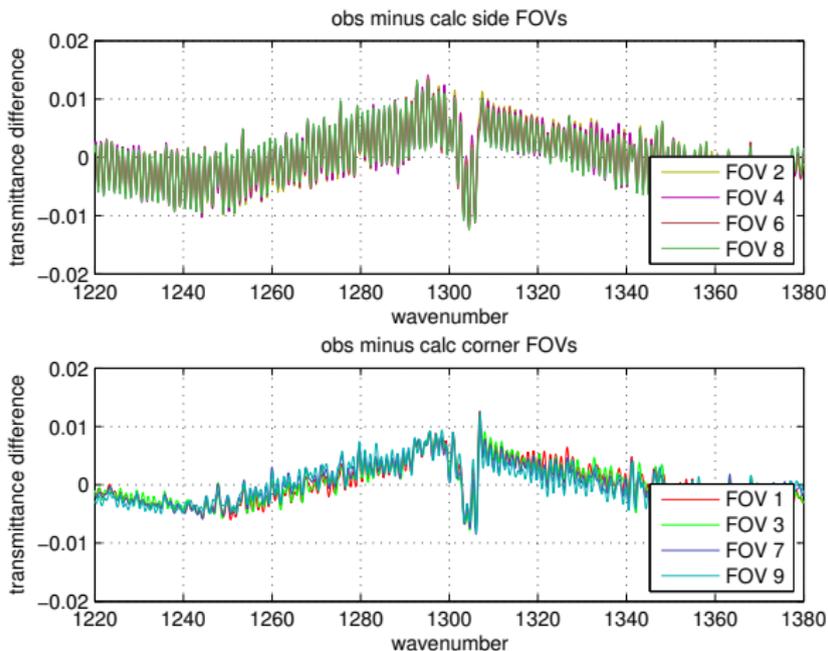
Observed and calculated transmittance for all FOVs, over the fitting interval. At this level of detail we see all values are very close.

CH₄ obs minus calc



Observed minus calculated transmittance for all FOVs and for FOV 5 alone, over the fitting interval.

CH₄ obs minus calc



Observed minus calculated transmittance for side and corner FOVs, over the fitting interval.

CH₄ tabulated residuals

metrology laser absolute residuals, ppm

0.26	5.93	13.93	7	4	1
-8.51	2.84	2.32	8	5	2
1.81	-1.03	-0.26	9	6	3

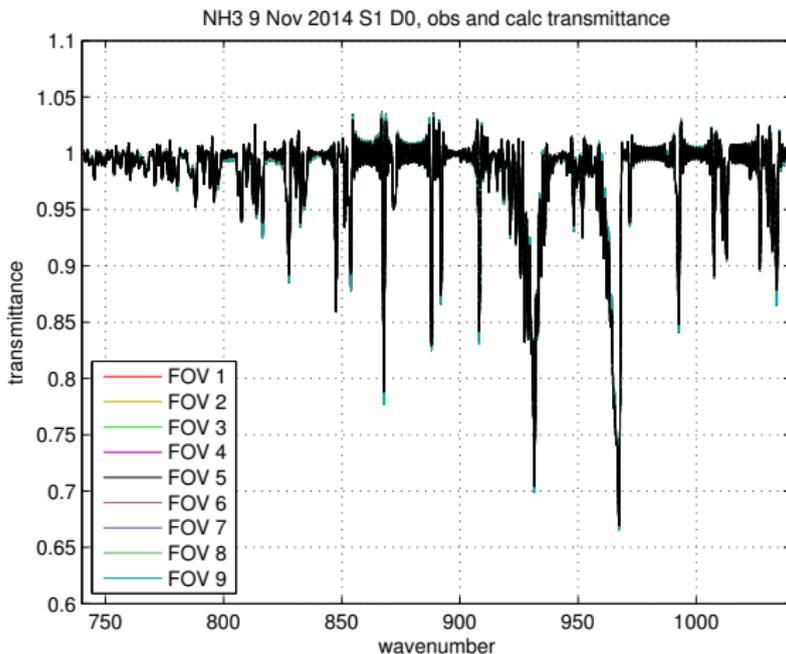
regression fitting weights and residuals

FOV	"a"	"b"	dmin	wmin	wfov
1	1.009	-0.0070	0.0036	13.93	775.3894
2	1.010	-0.0089	0.0044	2.32	775.3804
3	1.009	-0.0087	0.0036	-0.26	775.3784
4	1.014	-0.0124	0.0042	5.93	775.3832
5	1.012	-0.0109	0.0038	2.84	775.3808
6	1.016	-0.0152	0.0041	-1.03	775.3778
7	1.015	-0.0123	0.0033	0.26	775.3788
8	1.020	-0.0173	0.0041	-8.51	775.3720
9	0.999	0.0000	0.0033	1.81	775.3800

NH₃ test parameters

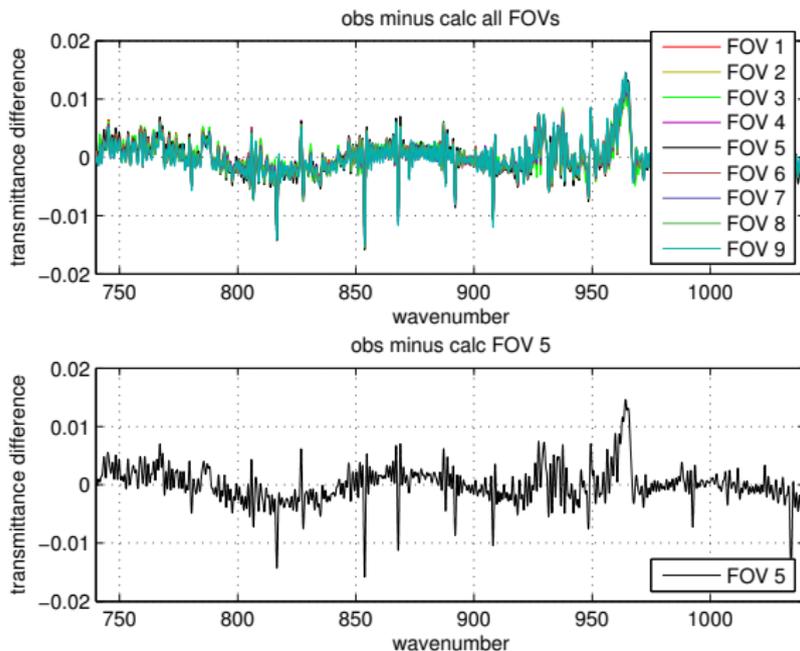
- ▶ LW PFH, 9 Nov 2014
- ▶ side 1, sweep direction 0
- ▶ fitting interval 740 to 1040 cm⁻¹
- ▶ metrology laser 775.3773 nm from neon cal
- ▶ Oct 2013 Exelis side 1 focal plane values
- ▶ ILS with periodic sinc wrap at the sensor grid
- ▶ HTBB nominal T1 360 K, T2 320 K
- ▶ 330 observations in each test leg
- ▶ gas cell nominal pressure 20.3 torr
- ▶ gas cell observed pressure 3.4 torr
- ▶ gas cell temperature 18.2 C
- ▶ gas cell length 12.59 cm

NH₃ obs and calc



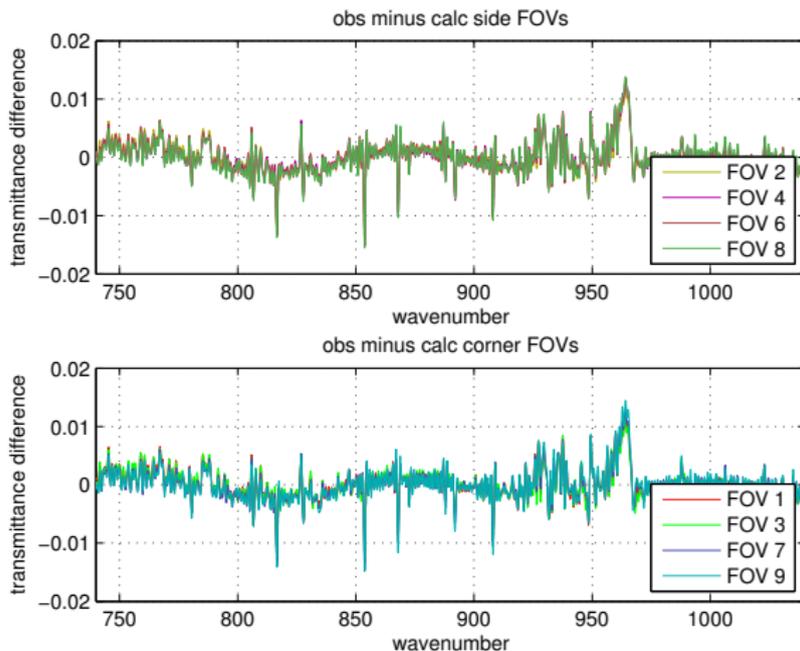
Observed and calculated transmittance for all FOVs, over the fitting interval. At this level of detail we see all values are close.

NH₃ obs minus calc



Observed minus calculated transmittance for all FOVs and for FOV 5 alone, over the fitting interval.

NH₃ obs minus calc



Observed minus calculated transmittance for side and corner FOVs, over the fitting interval.

NH₃ tabulated residuals

metrology laser absolute residuals, ppm

6.45	14.44	20.64	7	4	1
4.13	12.64	12.64	8	5	2
12.64	11.61	10.58	9	6	3

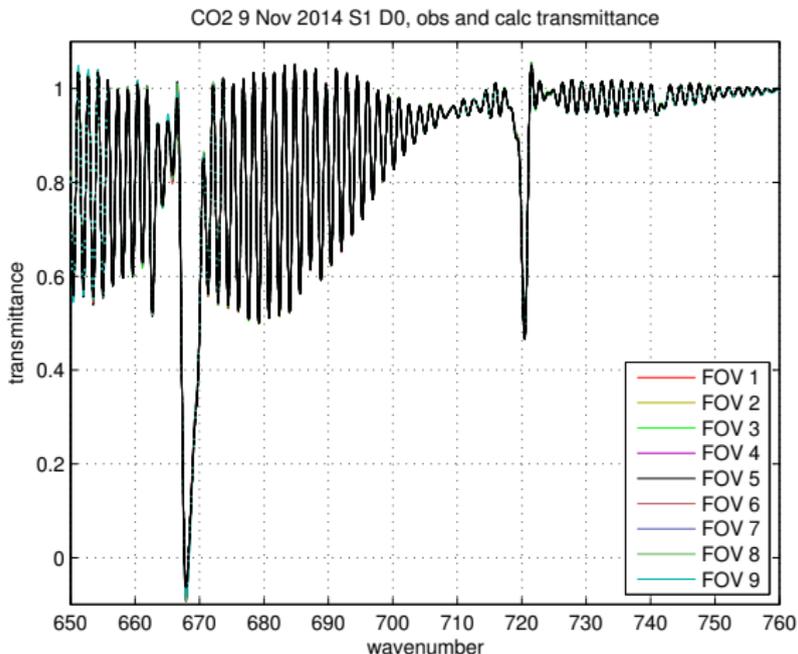
regression fitting weights and residuals

FOV	"a"	"b"	dmin	wmin	wfov
1	1.016	-0.0138	0.0027	20.64	775.3933
2	1.012	-0.0098	0.0027	12.64	775.3871
3	1.024	-0.0210	0.0026	10.58	775.3855
4	1.012	-0.0096	0.0028	14.44	775.3885
5	0.989	0.0112	0.0031	12.64	775.3871
6	1.017	-0.0145	0.0028	11.61	775.3863
7	1.018	-0.0165	0.0027	6.45	775.3823
8	1.008	-0.0078	0.0029	4.13	775.3805
9	1.013	-0.0111	0.0029	12.64	775.3871

CO₂ side 1 test parameters

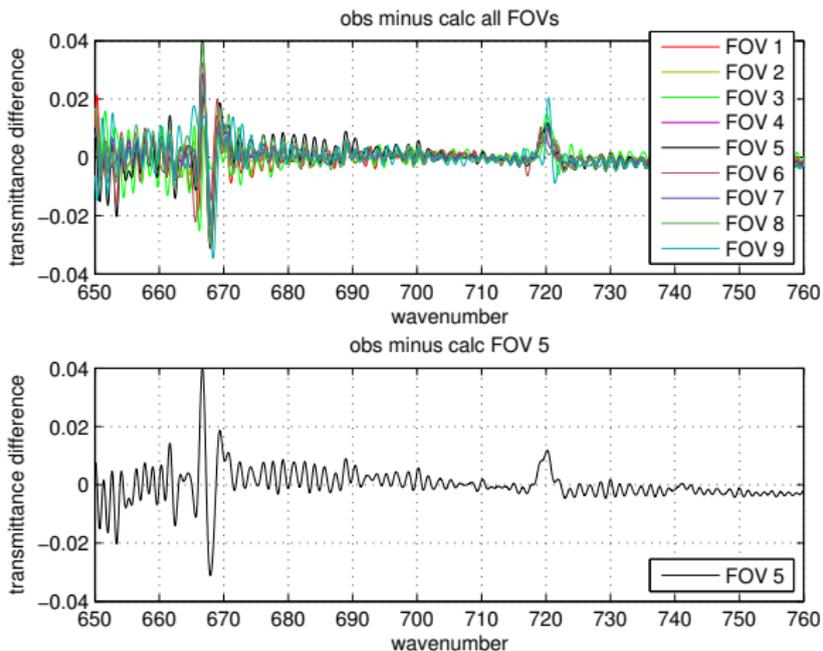
- ▶ LW PFH, 9 Nov 2014
- ▶ side 1, sweep direction 0
- ▶ fitting interval 650 to 760 cm⁻¹
- ▶ metrology laser 775.3773 nm from neon cal
- ▶ Oct 2013 Exelis side 1 focal plane values
- ▶ ILS with periodic sinc wrap at the sensor grid
- ▶ HTBB nominal T1 360 K, T2 320 K
- ▶ 330 observations in each test leg
- ▶ gas cell nominal pressure 40 torr
- ▶ gas cell observed pressure 40.5 torr × 0.97
- ▶ gas cell temperature 18.1 C
- ▶ gas cell length 12.59 cm

CO₂ side 1 obs and calc



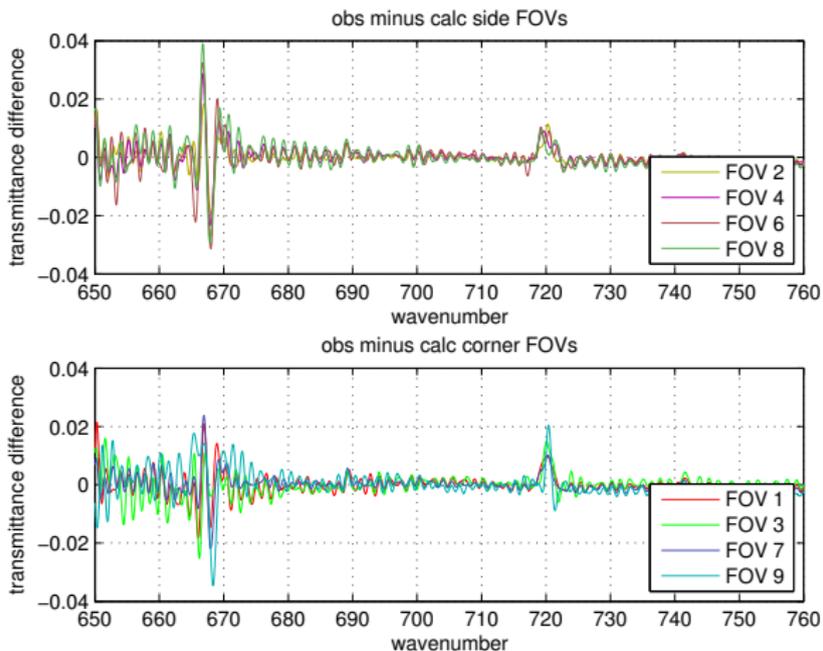
Observed and calculated transmittance for all FOVs, over the fitting interval. At this level of detail we see all values are close.

CO₂ side 1 obs minus calc



Observed minus calculated transmittance for all FOVs and for FOV 5 alone, over the fitting interval.

CO₂ side 1 obs minus calc



Observed minus calculated transmittance for side and corner FOVs, over the fitting interval.

CO₂ side 1 tabulated residuals

metrology laser absolute residuals, PPM

-1.55	7.48	14.19	7	4	1
-2.06	6.45	4.64	8	5	2
1.03	4.13	3.35	9	6	3

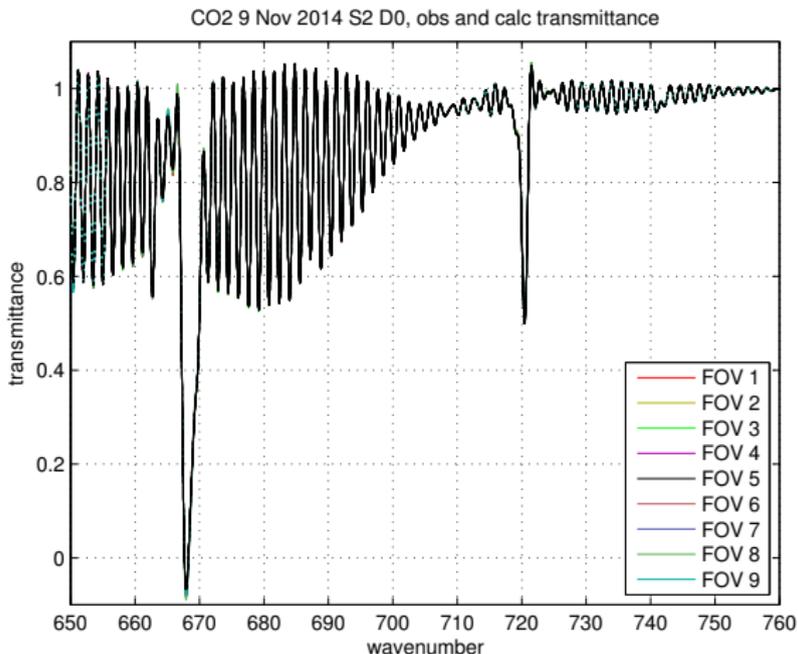
regression fitting weights and residuals

FOV	"a"	"b"	dmin	wmin	wfov
1	1.008	-0.0120	0.0036	14.19	775.3883
2	0.999	-0.0031	0.0031	4.64	775.3809
3	1.016	-0.0183	0.0040	3.35	775.3799
4	0.996	-0.0003	0.0038	7.48	775.3831
5	0.943	0.0509	0.0059	6.45	775.3823
6	1.001	-0.0053	0.0049	4.13	775.3805
7	1.008	-0.0118	0.0032	-1.55	775.3761
8	0.991	0.0045	0.0051	-2.06	775.3757
9	0.997	-0.0018	0.0052	1.03	775.3781

CO₂ side 2 test parameters

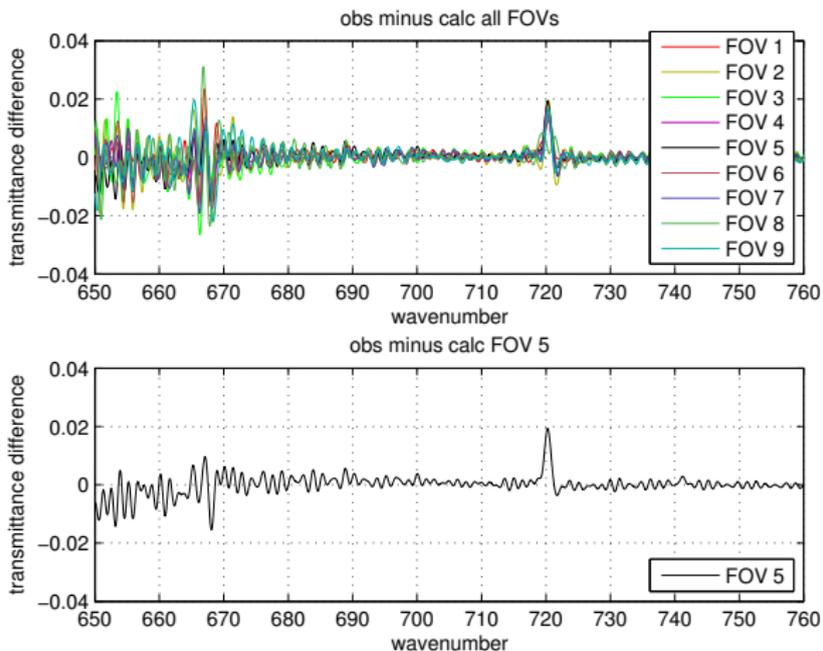
- ▶ LW PFH, 9 Nov 2014
- ▶ side 2, sweep direction 0
- ▶ fitting interval 650 to 760 cm⁻¹
- ▶ metrology laser 775.2993 from neon cal
- ▶ Oct 2013 Exelis side 1 focal plane values
- ▶ ILS with periodic sinc wrap at the sensor grid
- ▶ HTBB nominal T1 360 K, T2 320 K
- ▶ 330 observations in each test leg
- ▶ gas cell nominal pressure 41 torr
- ▶ gas cell observed pressure 40.5 torr × 0.85
- ▶ gas cell temperature 18.1 C
- ▶ gas cell length 12.59 cm

CO₂ side 2 obs and calc



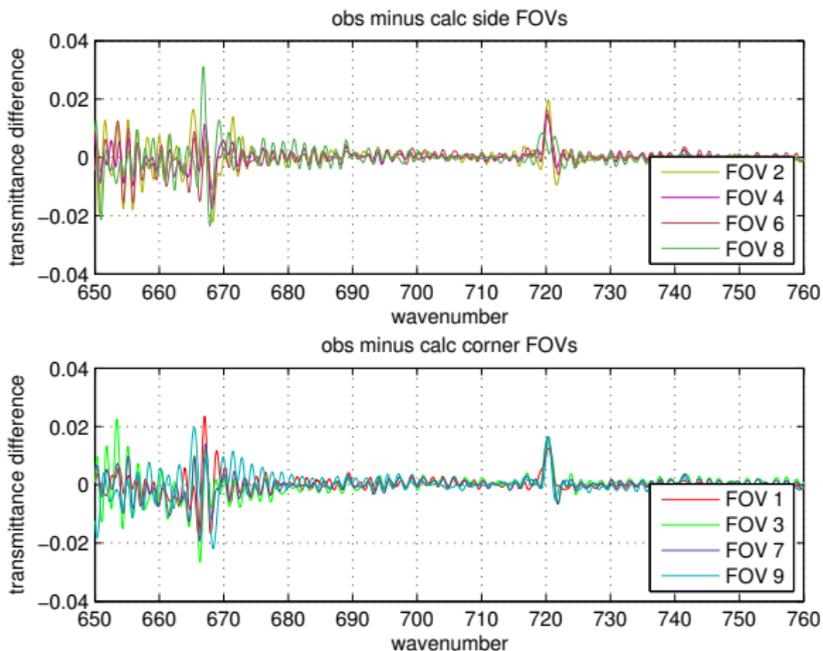
Observed and calculated transmittance for all FOVs, over the fitting interval. At this level of detail we see all values are close.

CO₂ side 2 obs minus calc



Observed minus calculated transmittance for all FOVs and for FOV 5 alone, over the fitting interval.

CO₂ side 2 obs minus calc



Observed minus calculated transmittance for side and corner FOVs, over the fitting interval.

CO₂ side 2 tabulated residuals

metrology laser absolute residuals, PPM

-2.58	5.68	13.16	7	4	1
-4.39	3.10	2.32	8	5	2
-0.77	1.03	1.81	9	6	3

regression fitting weights and residuals

FOV	"a"	"b"	dmin	wmin	wfov
1	1.011	-0.0091	0.0032	13.16	775.3095
2	1.005	-0.0027	0.0043	2.32	775.3011
3	1.025	-0.0196	0.0043	1.81	775.3007
4	1.006	-0.0029	0.0028	5.68	775.3037
5	0.957	0.0444	0.0034	3.10	775.3017
6	1.014	-0.0106	0.0033	1.03	775.3001
7	1.021	-0.0185	0.0033	-2.58	775.2973
8	0.998	0.0028	0.0042	-4.39	775.2959
9	1.002	-0.0010	0.0040	-0.77	775.2987

FOV 5 residual comparison

Side 1 MN FOV 5 absolute metrology laser residuals, ppm

gas	date	residual	comments
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CO	10-15	3.1	test OK
CH4	10-16	2.9	test OK
CO2	10-16	3.9	672-704 cm-1 UMBC LBL
NH3	10-16	3.6	test OK

Side 1 PH FOV 5 absolute metrology laser residuals, ppm

gas	date	residual	comments
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CO	10-02	3.1	40 torr log, 26 torr obs
CH4	11-05	2.8	test OK
CO2	11-09	6.4	650-760 cm-1 LBLRTM
CO2	11-09	5.4	672-704 cm-1 LBLRTM
NH3	11-09	12.6	20.3 torr log, 3.4 torr obs

FOV 5 residual comparison

Side 2 MN FOV 5 absolute metrology laser residuals, ppm

gas	date	residual	comments
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CO	10-18	2.6	test OK
CH4	10-18	2.6	test OK
CO2	10-18	3.7	650-760 cm-1 LBLRTM
CO2	10-18	3.9	672-704 cm-1 LBLRTM
NH3	10-18	11.9	40.4 torr log, 6.3 torr obs

Side 2 PH FOV 5 absolute metrology laser residuals, ppm

gas	date	residual	comments
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CO2	11-09	3.1	650-760 cm-1 LBLRTM
CO2	11-09	4.4	672-704 cm-1 LBLRTM
NH3	09-27	10.8	39 torr log, 7 torr obs

notes and future work

Notes

- ▶ for side 2 CO₂, the broader fitting interval gave slightly smaller metrology laser residuals
- ▶ the side 1 MN NH₃ test, the only case where nominal and observed pressures were close, had a FOV 5 metrology laser residual consistent with other tests
- ▶ all tests were done using UMBC LBL, except as noted

Future work

- ▶ add non-linearity correction to the transmittance calculation
- ▶ adjust focal plane model to reduce residuals
- ▶ compare sweep directions