Comparison of AIRS V5 and 3 CANDIDATE V6's

H. Van Dang and Evan Manning

What will be presented today:

1. Radiative consistency and the extent of its usefulness
2. Effective global cloud coverage trend
3. Comparison of AIRS Cloud Top Height to CloudSat and CALIPSO
4. Addressing the high clouds that have splotchy formations that Evan Manning detected

Findings:

1. SCCNN is more radiatively consistent in its retrievals than the MODIS EMISSIVITY and the CLIMATOLOGY versions, although not as good as V5. Radiative consistency does not take into account water vapor correction and so it is only good for very large errors or for where there is a reported clear sky field of view.

2. The global increase in effective cloud coverage from year to year in V5 is almost non-existent in SCCNN.

3. SCCNN in general compares better than V5 and all versions of candidate V6 to CALIPSO and CloudSat cloud top height.

$$CBT = P_{1231}^{-1}\left(f_1 \cdot P_{1231}(ctt_1) + f_2 \cdot P_{1231}(ctt_2) + (1 - f_1 - f_2) \cdot emis_{1231} \cdot P_{1231}(st)\right)$$

$$OBT = P_{1231}^{-1}\left(RAD_{1231}\right)$$

P_{1231}^{-1} : inverse Planck fuction at wavenumber 1231cm^{-1}

P_{1231} : Planck fuction at wavenumber 1231cm^{-1}

$f_{1/2}$: effective cloud fraction at top (1) or bottom (2) layer

$ctt_{1/2}$: cloud top temperature of top (1) or bottom (2) layer

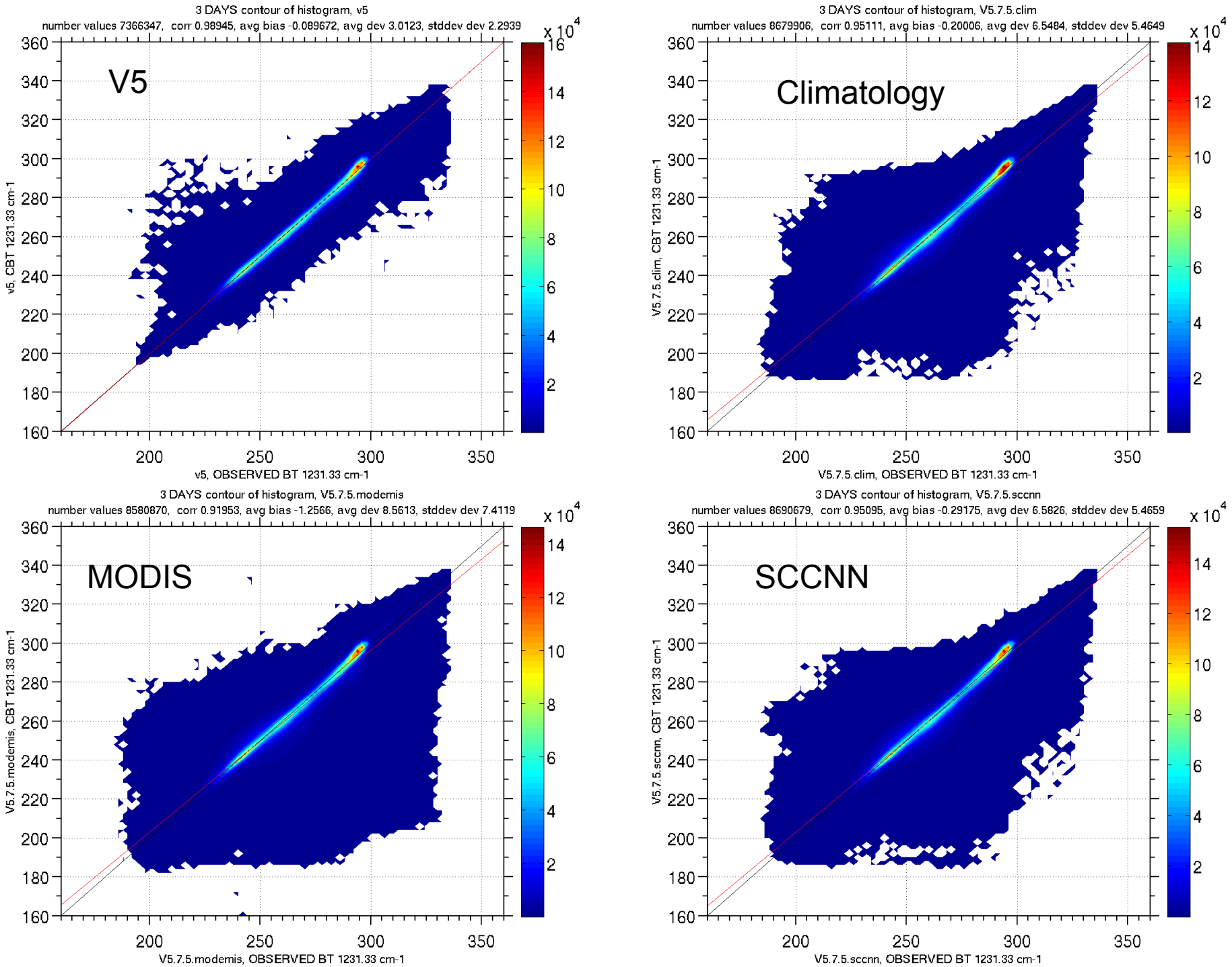
$emis_{1231}$: emissivity near 1231 cm^{-1}

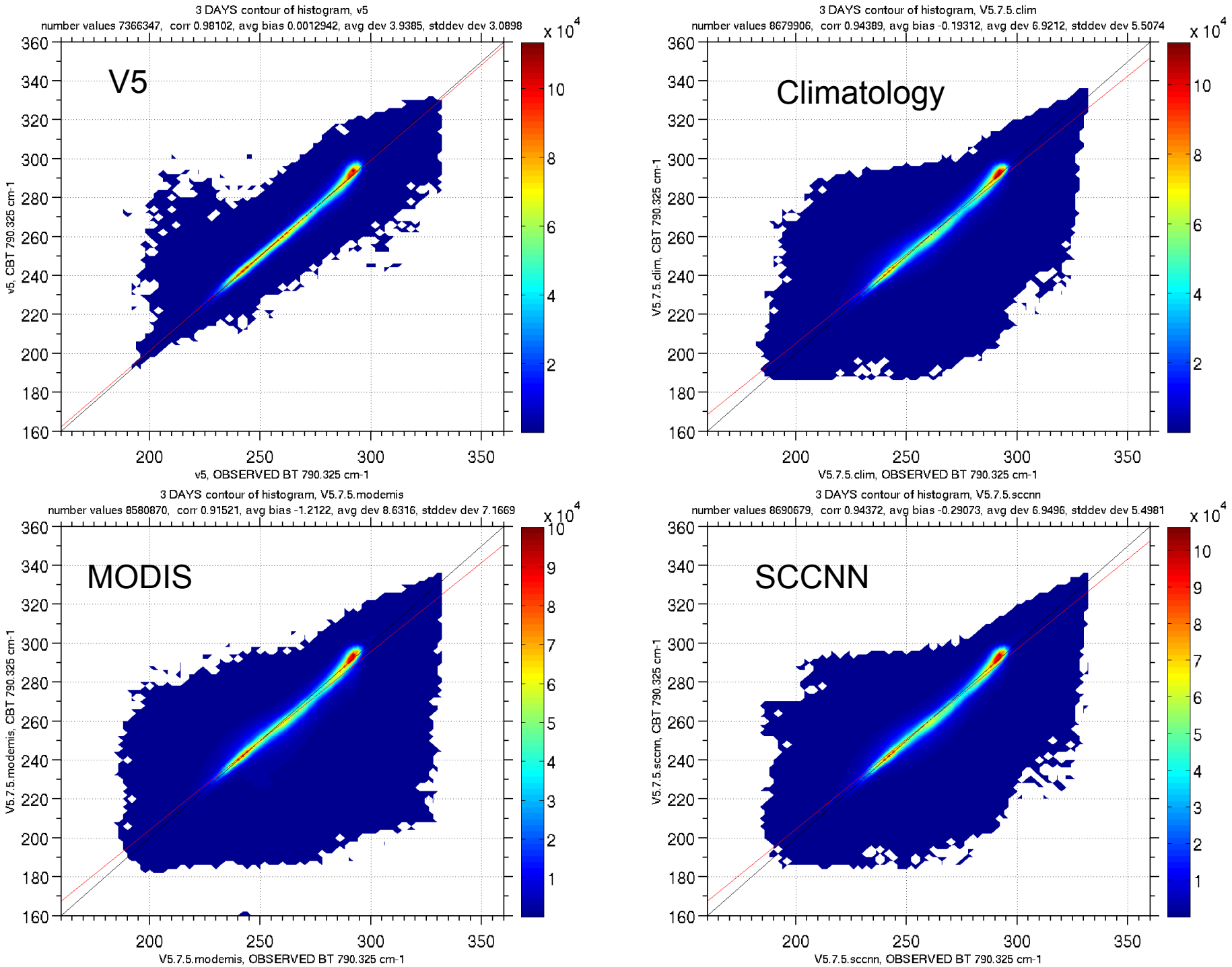
st : surface temperature retrieved from AIRS

Next 2 slides shows 3 days of comparison between OBSERVED BRIGHTNESS TEMPERATURE (OBT) and CALCULATED BRIGHTNESS TEMPERATURE (CBT) without the fix hwgt from 5000 to 2.5.

Slide 4: using 1231 cm^{-1}

Slide 5: using 790 cm-1

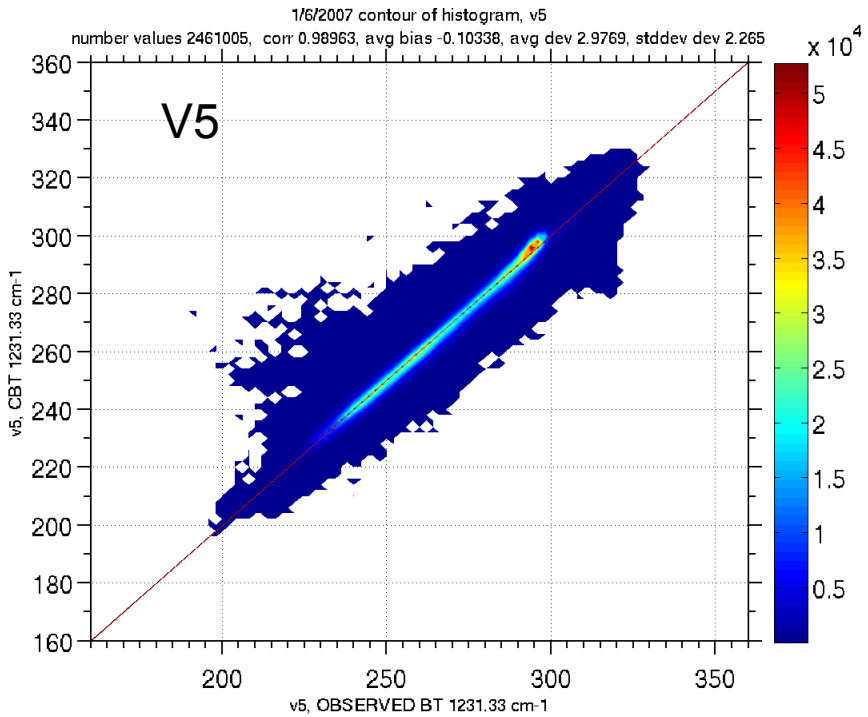

3 DAYS contour of histogram, v5
number values 7366347, corr 0.98945, avg bias -0.089672, avg dev 3.0123, stddev dev 2.2939
V5
v5, CBT 1231.33 cm-1
v5, OBSERVED BT 1231.33 cm-1
x 10^4
3 DAYS contour of histogram, V5.7.5.clim
number values 8679906, corr 0.95111, avg bias -0.20006, avg dev 6.5484, stddev dev 5.4649
Climatology
V5.7.5.clim, CBT 1231.33 cm-1
V5.7.5.clim, OBSERVED BT 1231.33 cm-1
x 10^4
3 DAYS contour of histogram, V5.7.5.modemis
number values 8580870, corr 0.91953, avg bias -1.2566, avg dev 8.5613, stddev dev 7.4119
MODIS
V5.7.5.modemis, CBT 1231.33 cm-1
V5.7.5.modemis, OBSERVED BT 1231.33 cm-1
x 10^4
3 DAYS contour of histogram, V5.7.5.sccnn
number values 8690679, corr 0.95095, avg bias -0.29175, avg dev 6.5826, stddev dev 5.4659
SCCNN
V5.7.5.sccnn, CBT 1231.33 cm-1
V5.7.5.sccnn, OBSERVED BT 1231.33 cm-1
x 10^4

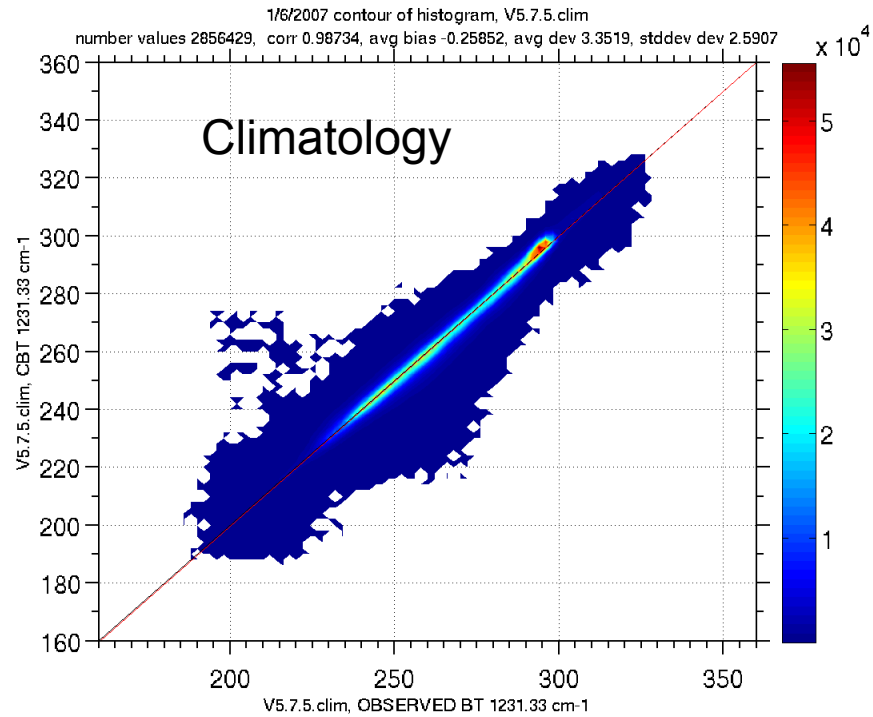

3 DAYS contour of histogram, v5
number values 7366347, corr 0.98102, avg bias 0.0012942, avg dev 3.9385, stddev dev 3.0898
V5
v5, CBT 790.325 cm-1
v5, OBSERVED BT 790.325 cm-1
x 10^4
3 DAYS contour of histogram, V5.7.5.clim
number values 8679906, corr 0.94389, avg bias -0.19312, avg dev 6.9212, stddev dev 5.5074
Climatology
V5.7.5.clim, CBT 790.325 cm-1
V5.7.5.clim, OBSERVED BT 790.325 cm-1
x 10^4
3 DAYS contour of histogram, V5.7.5.modemis
number values 8580870, corr 0.91521, avg bias -1.2122, avg dev 8.6316, stddev dev 7.1669
MODIS
V5.7.5.modemis, CBT 790.325 cm-1
V5.7.5.modemis, OBSERVED BT 790.325 cm-1
x 10^4
3 DAYS contour of histogram, V5.7.5.sccnn
number values 8690679, corr 0.94372, avg bias -0.29073, avg dev 6.9496, stddev dev 5.4981
SCCNN
V5.7.5.sccnn, CBT 790.325 cm-1
V5.7.5.sccnn, OBSERVED BT 790.325 cm-1
x 10^4

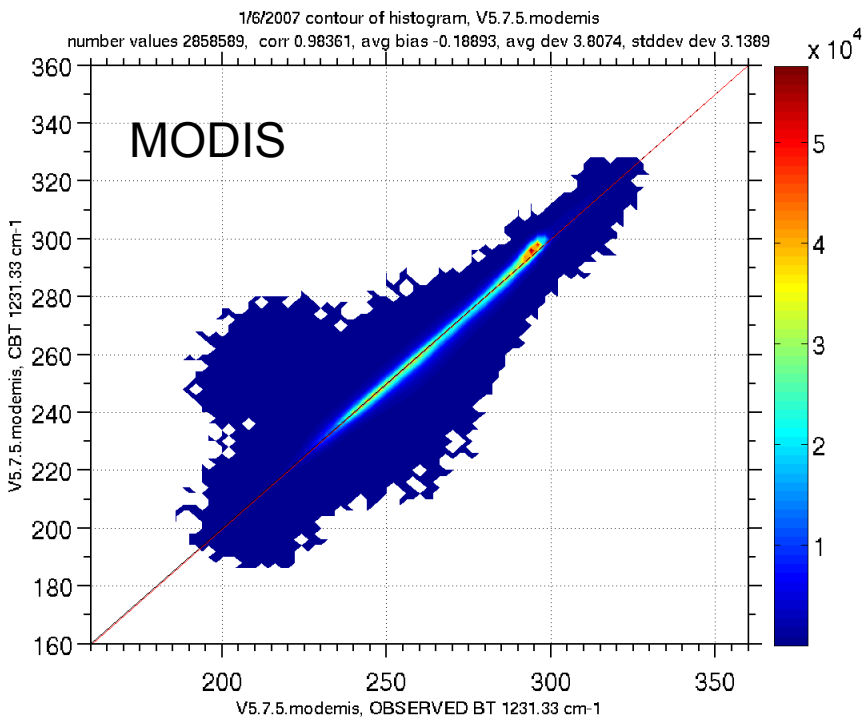
Next 2 slides shows 2 days of comparison between OBSERVED BRIGHTNESS TEMPERATURE (OBT) and CALCULATED BRIGHTNESS TEMPERATURE with the fix hwgt from 5000 to 2.5.

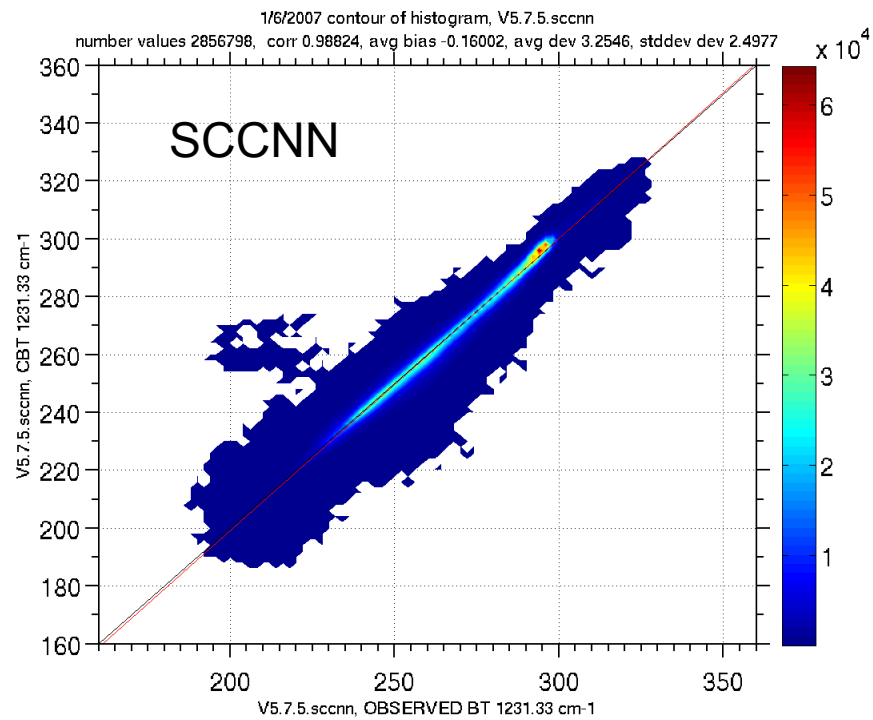
Slide 7: using 1231 cm^{-1}

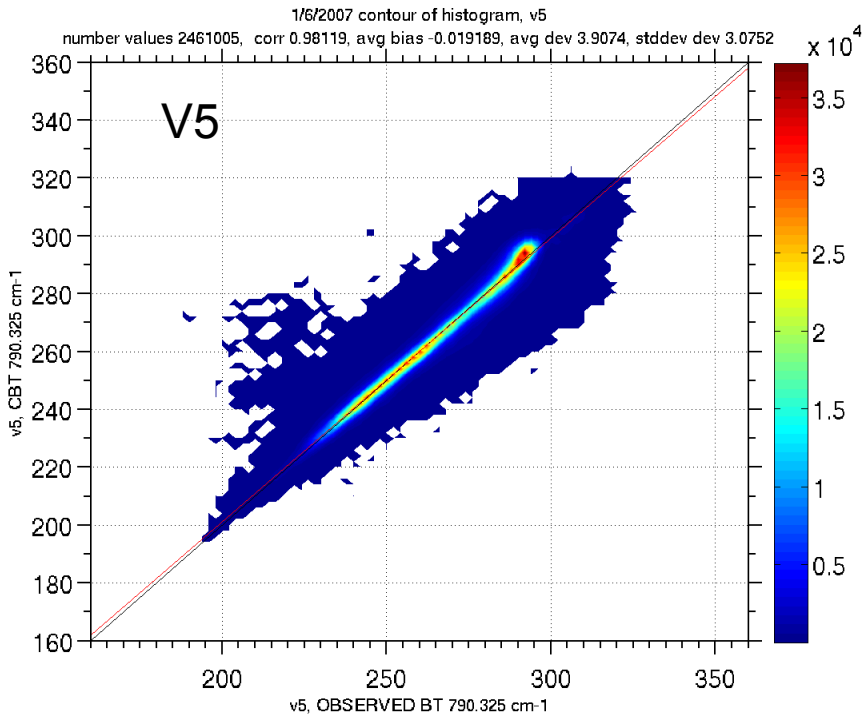
Slide 8: using 790 cm-1

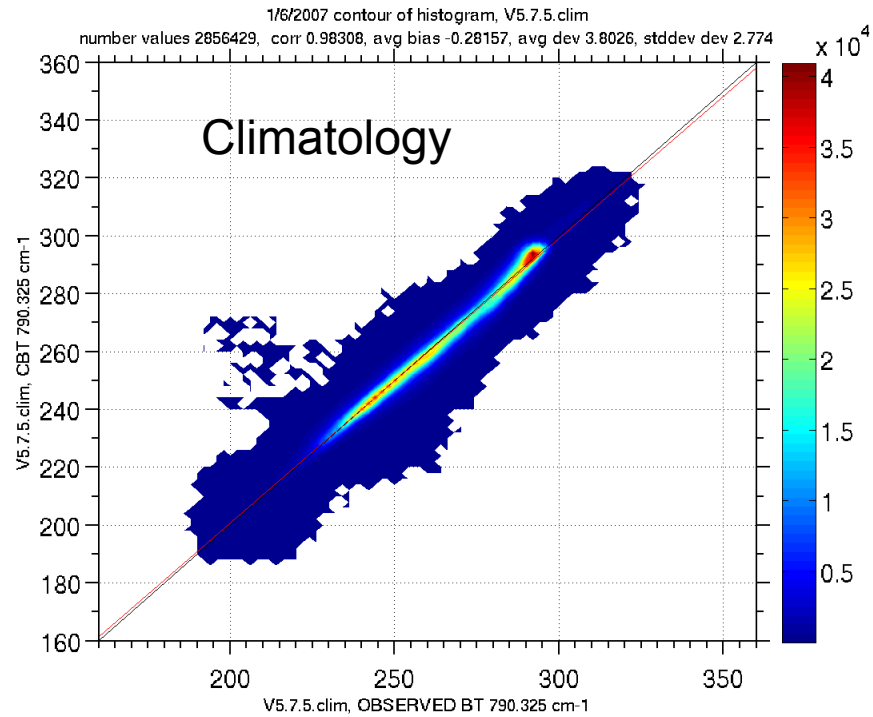

1/6/2007 contour of histogram, v5
number values 2461005, corr 0.98963, avg bias -0.10338, avg dev 2.9769, stddev dev 2.265
V5
v5, CBT 1231.33 cm-1
v5, OBSERVED BT 1231.33 cm-1
x 10^4

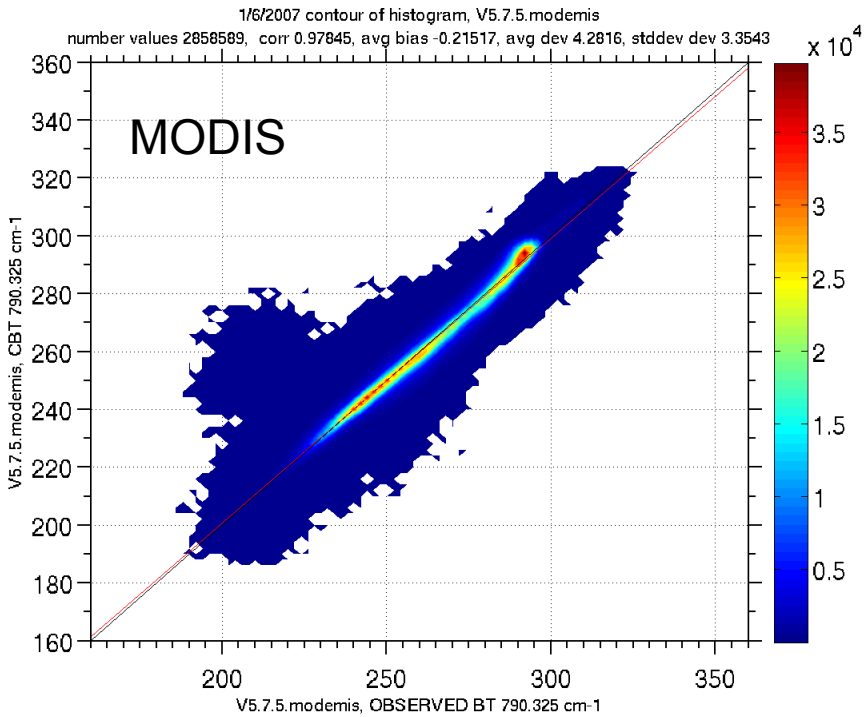

1/6/2007 contour of histogram, V5.7.5.clim
number values 2856429, corr 0.98734, avg bias -0.25852, avg dev 3.3519, stddev dev 2.5907
Climatology
V5.7.5.clim, CBT 1231.33 cm-1
V5.7.5.clim, OBSERVED BT 1231.33 cm-1
x 10^4

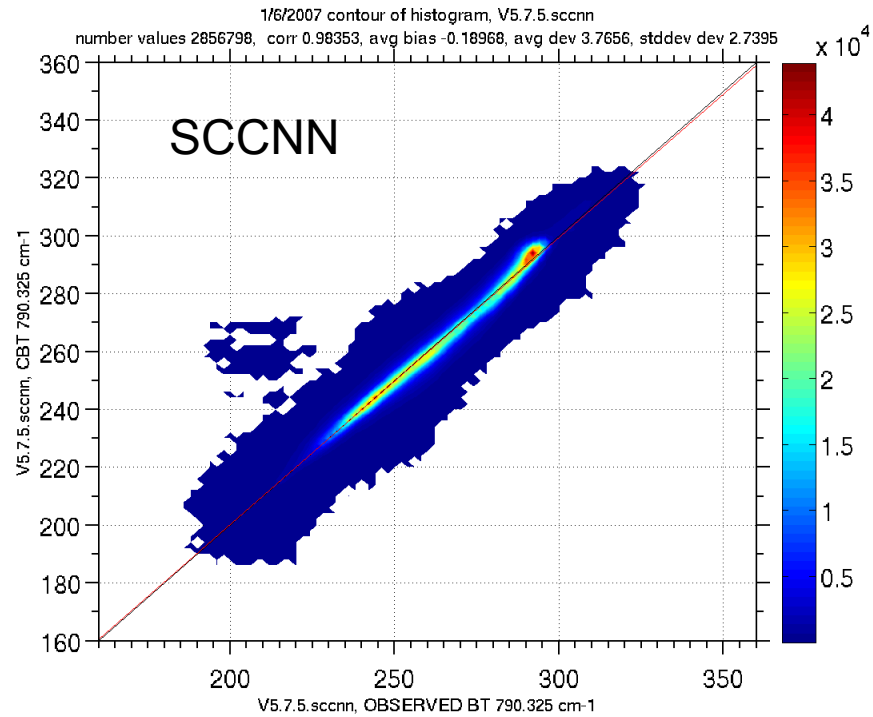

1/6/2007 contour of histogram, V5.7.5.modemis
number values 2858589, corr 0.98361, avg bias -0.18893, avg dev 3.8074, stddev dev 3.1389
MODIS
V5.7.5.modemis, CBT 1231.33 cm-1
V5.7.5.modemis, OBSERVED BT 1231.33 cm-1
x 10^4

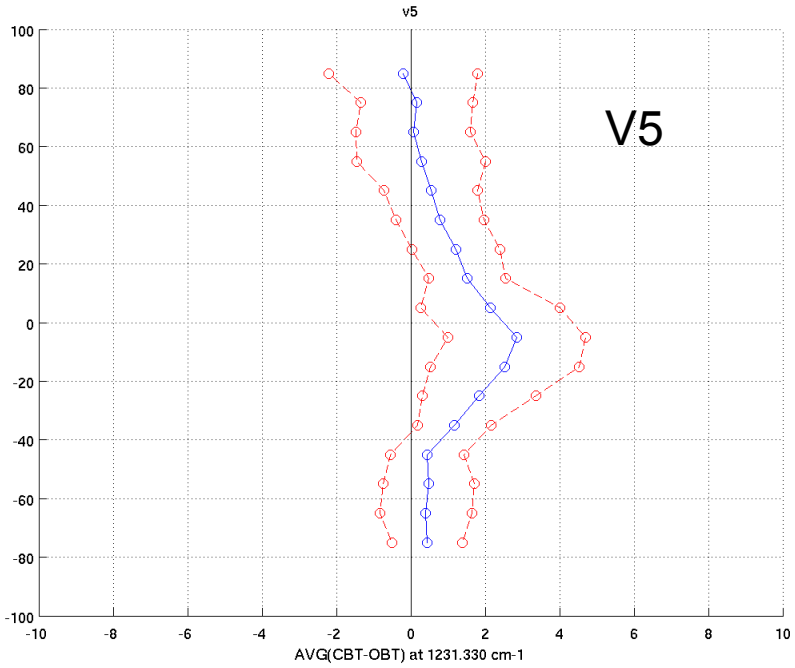

1/6/2007 contour of histogram, V5.7.5.sccnn
number values 2856798, corr 0.98824, avg bias -0.16002, avg dev 3.2546, stddev dev 2.4977
SCCNN
V5.7.5.sccnn, CBT 1231.33 cm-1
V5.7.5.sccnn, OBSERVED BT 1231.33 cm-1
x 10^4

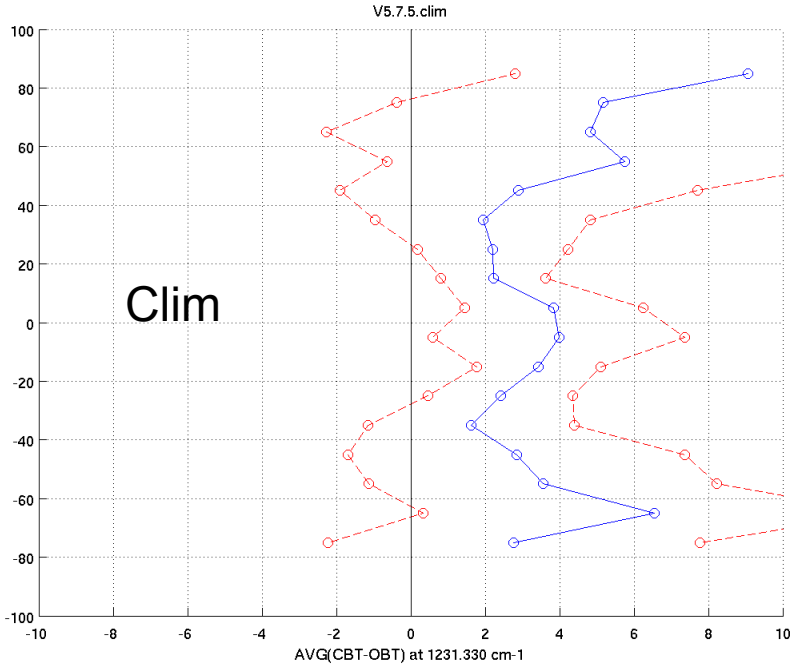

1/6/2007 contour of histogram, v5
number values 2461005, corr 0.98119, avg bias -0.019189, avg dev 3.9074, stddev dev 3.0752
V5
v5, CBT 790.325 cm-1
v5, OBSERVED BT 790.325 cm-1
x 10^4

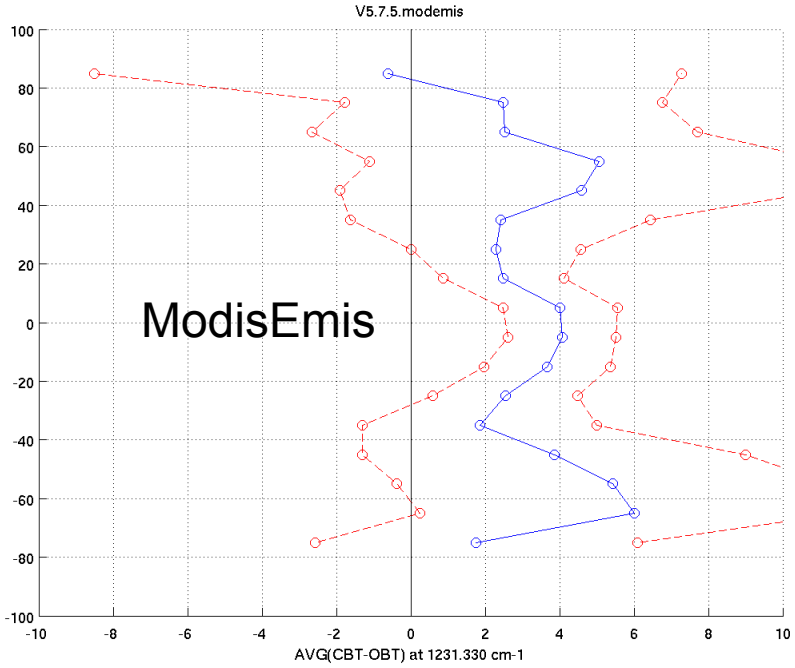

1/6/2007 contour of histogram, V5.7.5.clim
number values 2856429, corr 0.98308, avg bias -0.28157, avg dev 3.8026, stddev dev 2.774
Climatology
V5.7.5.clim, CBT 790.325 cm-1
V5.7.5.clim, OBSERVED BT 790.325 cm-1
x 10^4

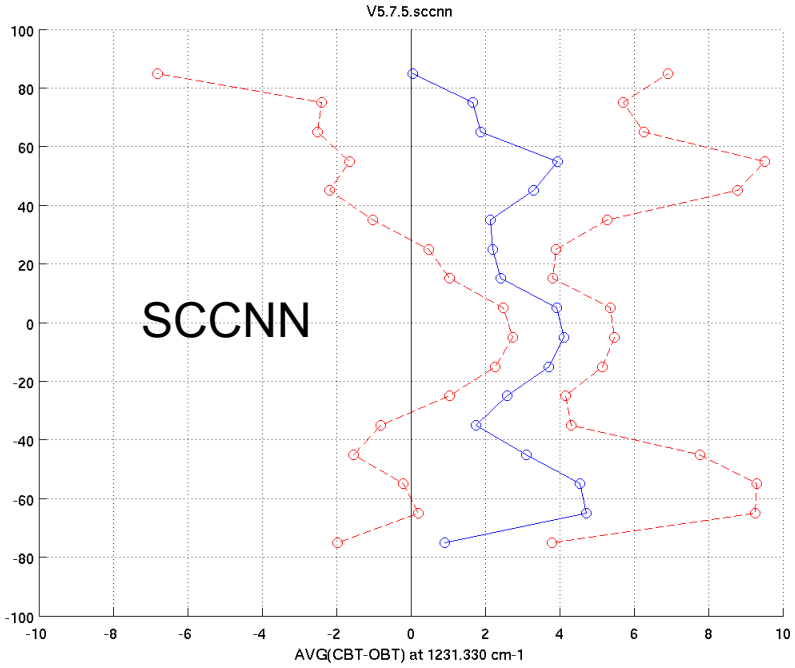

1/6/2007 contour of histogram, V5.7.5.modemis
number values 2858589, corr 0.97845, avg bias -0.21517, avg dev 4.2816, stddev dev 3.3543
MODIS
V5.7.5.modemis, CBT 790.325 cm-1
V5.7.5.modemis, OBSERVED BT 790.325 cm-1
x 10^4

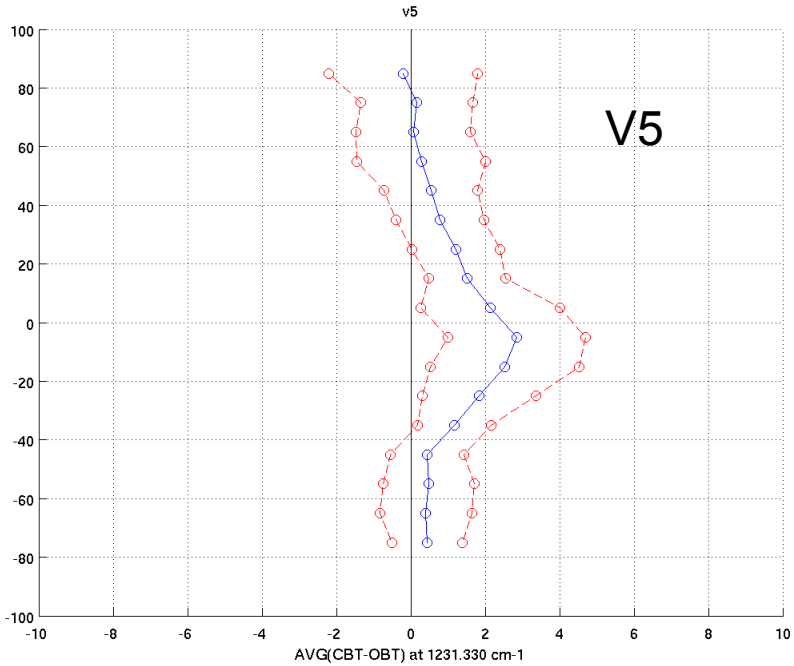

1/6/2007 contour of histogram, V5.7.5.sccnn
number values 2856798, corr 0.98353, avg bias -0.18968, avg dev 3.7656, stddev dev 2.7395
SCCNN
V5.7.5.sccnn, CBT 790.325 cm-1
V5.7.5.sccnn, OBSERVED BT 790.325 cm-1
x 10^4

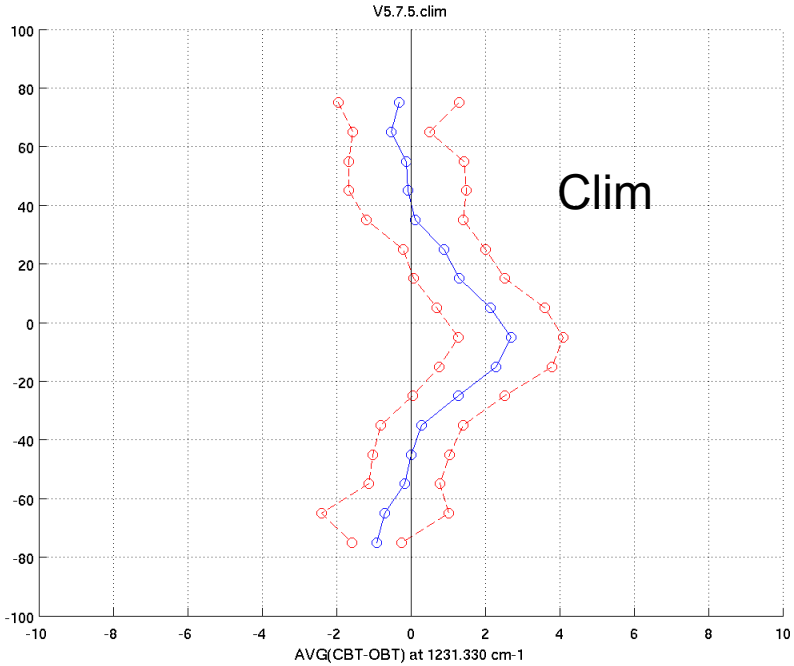

v5
V5
AVG(CBT-OBT) at 1231.330 cm-1

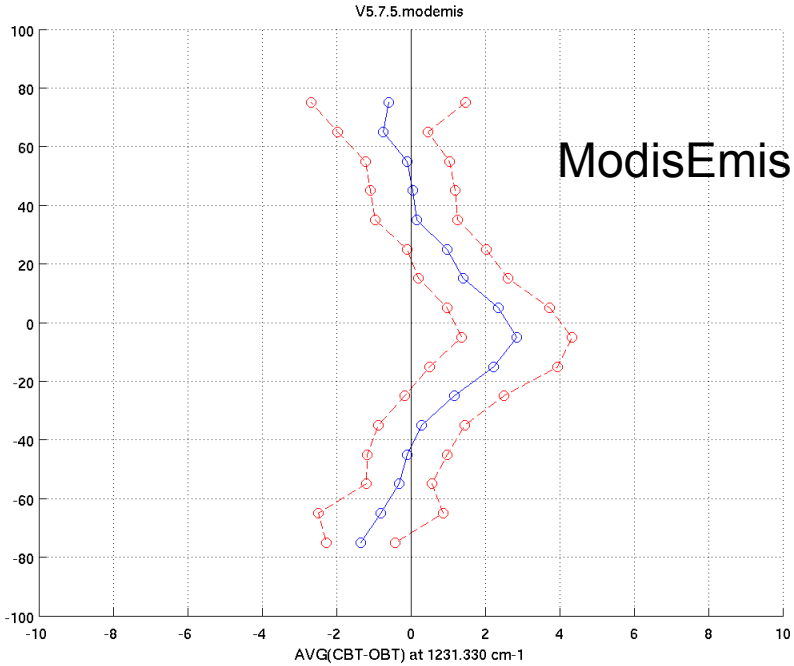

V5.7.5.clim
Clim
AVG(CBT-OBT) at 1231.330 cm-1

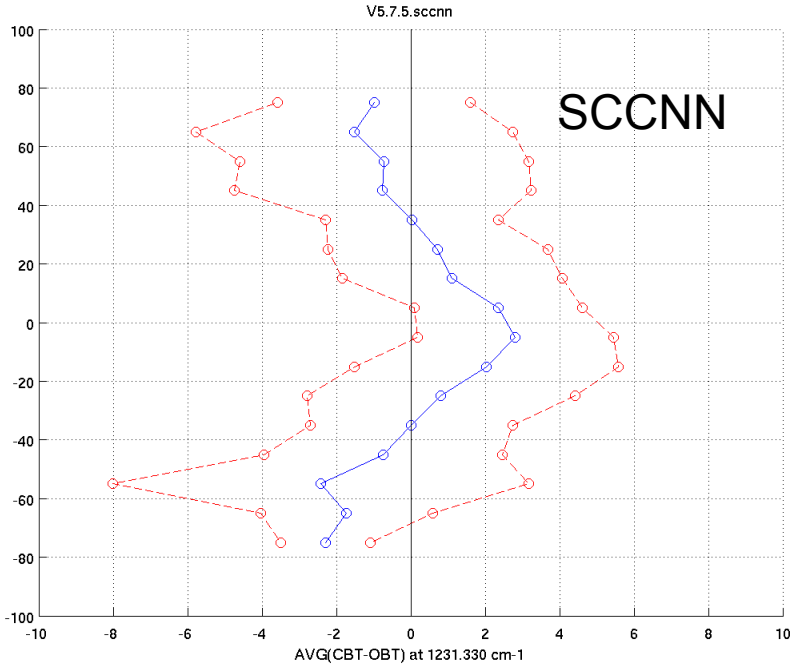

V5.7.5.modemis
ModisEmis
AVG(CBT-OBT) at 1231.330 cm-1

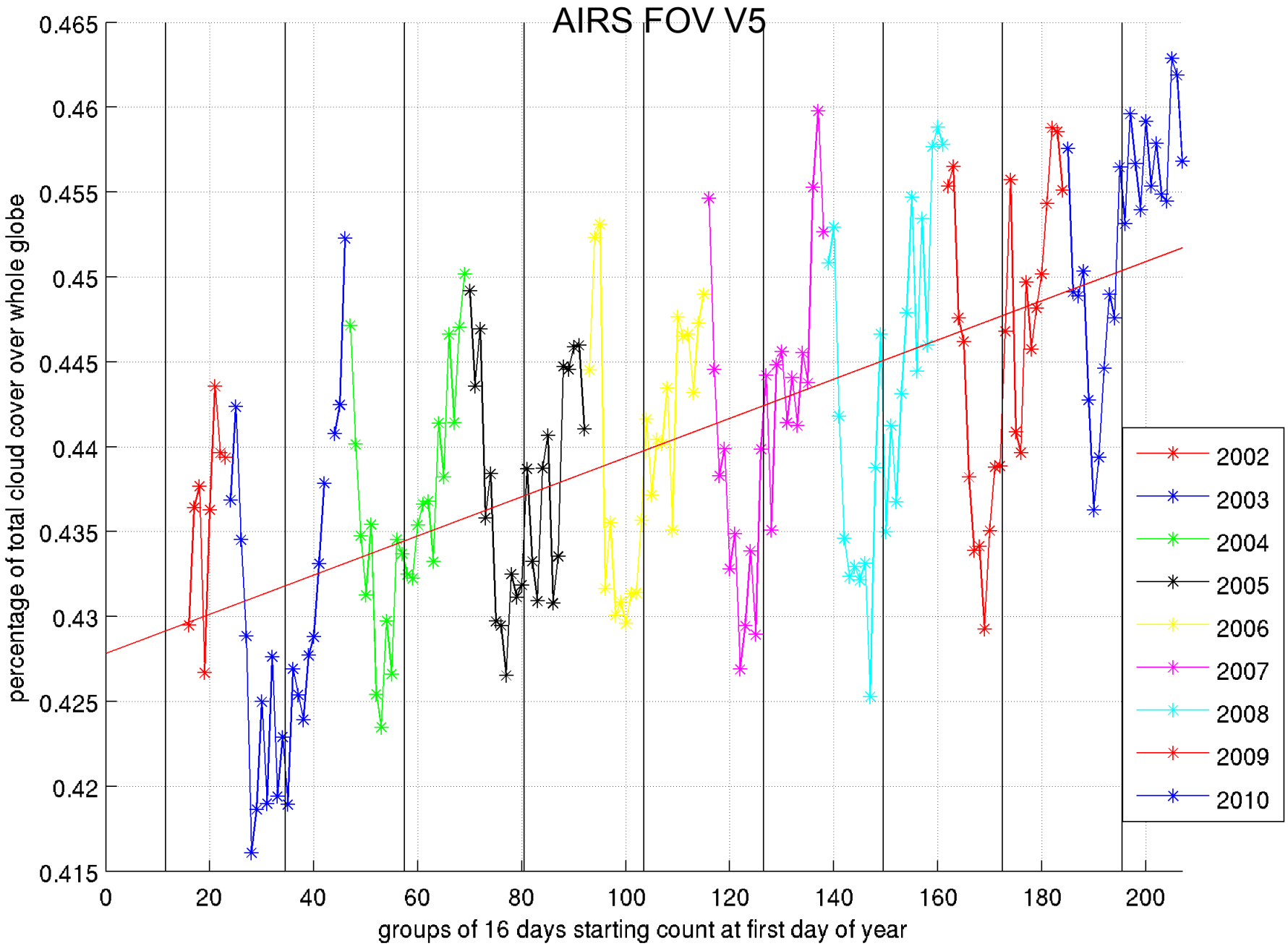

V5.7.5.sccnn
SCCNN
AVG(CBT-OBT) at 1231.330 cm-1


v5
V5
AVG(CBT-OBT) at 1231.330 cm-1

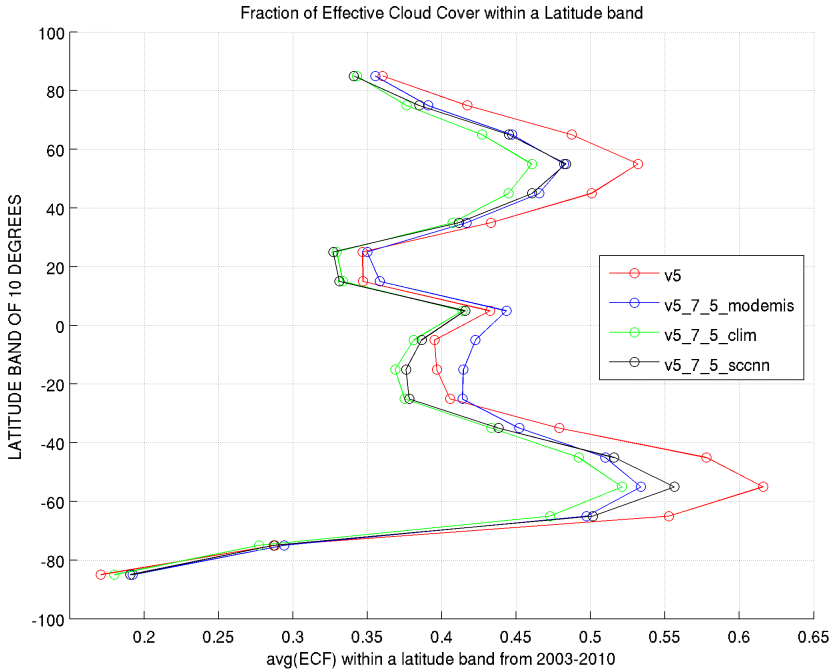

V5.7.5.clim
Clim
AVG(CBT-OBT) at 1231.330 cm-1

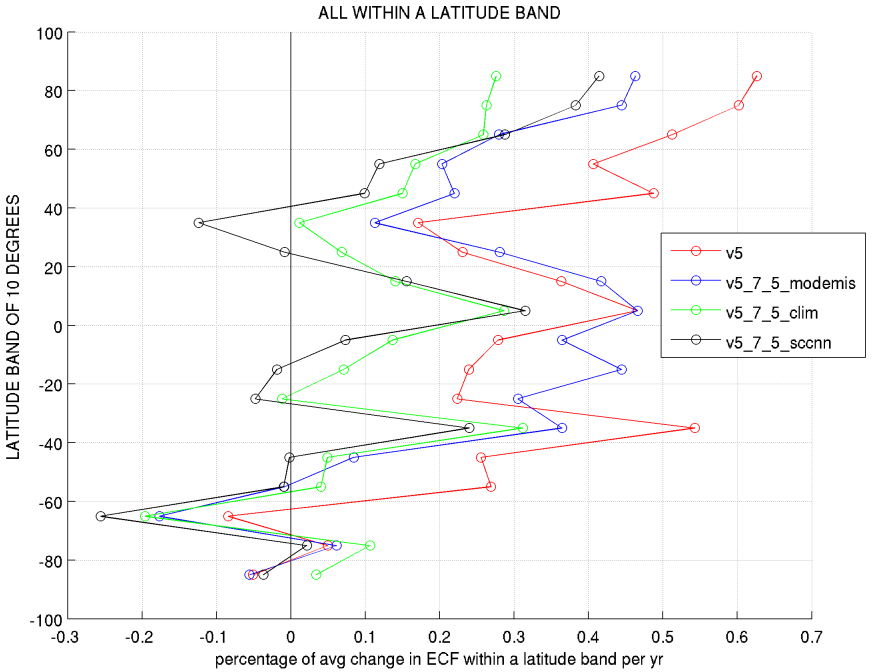

V5.7.5.modemis
ModisEmis
AVG(CBT-OBT) at 1231.330 cm-1


V5.7.5.sccnn
SCCNN
AVG(CBT-OBT) at 1231.330 cm-1


AIRS FOV V5
percentage of total cloud cover over whole globe
groups of 16 days starting count at first day of year
0.465
0.46
0.455
0.45
0.445
0.44
0.435
0.43
0.425
0.42
0.415
0
20
40
60
80
100
120
140
160
180
200
2002
2003
2004
2005
2006
2007
2008
2009
2010

Looking at the 3 candidate V6's without the damping parameter that enables greater radiative consistency, we see that the SCCNN and Climatology startup has greatly reduced the trend in effective cloud coverage.





1/6/2007 &
1/30/2007

COMPARED TO CLOUDSAT	NUMBER VALUES	CORRELATION	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)
V5	**40265**	**0.57**	**-2.07**	**3.33**	**3.92**	**2.83**
V5.7.5 CLIMATOLOGY w/ HGWT=2.5	**41953**	**0.63**	**-1.77**	**3.29**	**3.74**	**2.70**
V5.7.5 MODIS EMISSIVITY w/ HGWT=2.5	**42226**	**0.61**	**-1.92**	**3.37**	**3.88**	**2.81**
V5.7.5 SCCNN w/ HGWT=2.5	**42111**	**0.63**	**-1.67**	**3.28**	**3.68**	**2.71**

COMPARED TO CALIPSO	NUMBER VALUES	CORRELATION	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)
V5	**43535**	**0.68**	**0.33**	**3.74**	**3.75**	**2.59**
V5.7.5 CLIMATOLOGY w/ HGWT=2.5	**45106**	**0.67**	**0.60**	**3.81**	**3.86**	**2.68**
V5.7.5 MODIS EMISSIVITY w/ HGWT=2.5	**45393**	**0.70**	**0.38**	**3.65**	**3.67**	**2.55**
V5.7.5 SCCNN w/ HGWT=2.5	**45371**	**0.71**	**0.60**	**3.59**	**3.64**	**2.54**

1/6/2007 &
1/30/2007

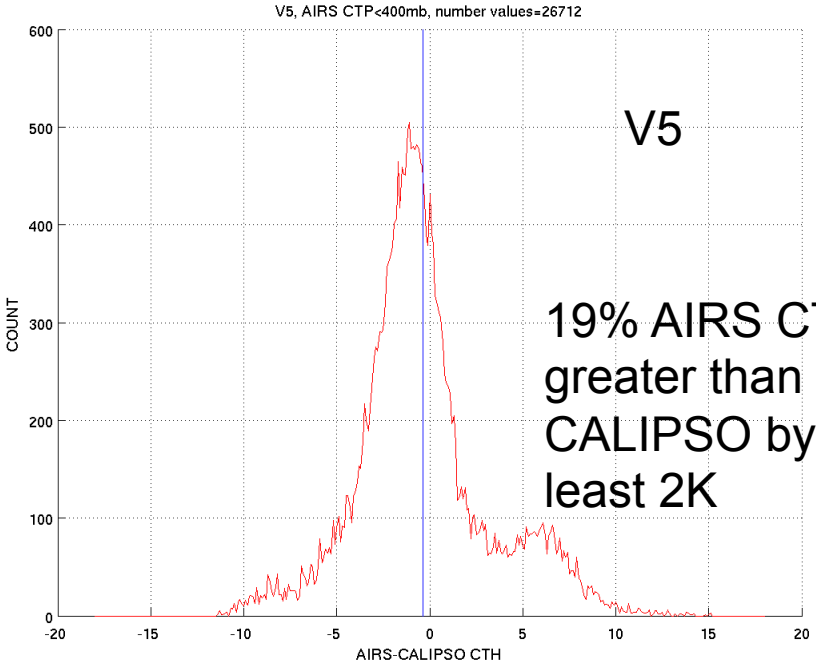
CALIPSO V3.1	V5						V5.7.5 CLIMATOLOGY w/ HGWT=2.5					
	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)
CIRRUS	3018	0.77	1.78	1.75	2.50	1.52	3030	0.70	1.81	2.05	2.73	1.67
ALTOSTRATUS	4130	0.73	1.08	1.96	2.24	1.45	4091	0.70	1.20	2.12	2.43	1.60
ALTOCUMULUS	2158	0.73	1.16	3.20	3.41	2.44	2173	0.69	1.01	3.37	3.52	2.56
STRATOCUMULUS	9047	0.63	-0.72	3.49	3.56	2.33	9283	0.64	-0.42	3.50	3.52	2.41
CUMULUS	639	0.74	-0.06	3.41	3.41	2.36	716	0.75	0.05	3.39	3.39	2.36
NIBOSTRATUS	4773	0.65	0.23	1.88	1.89	1.20	5177	0.66	0.34	2.00	2.03	1.36
DEEP CONVECTION	596	0.67	2.54	2.43	3.51	2.13	1130	0.62	2.23	2.51	3.36	2.20

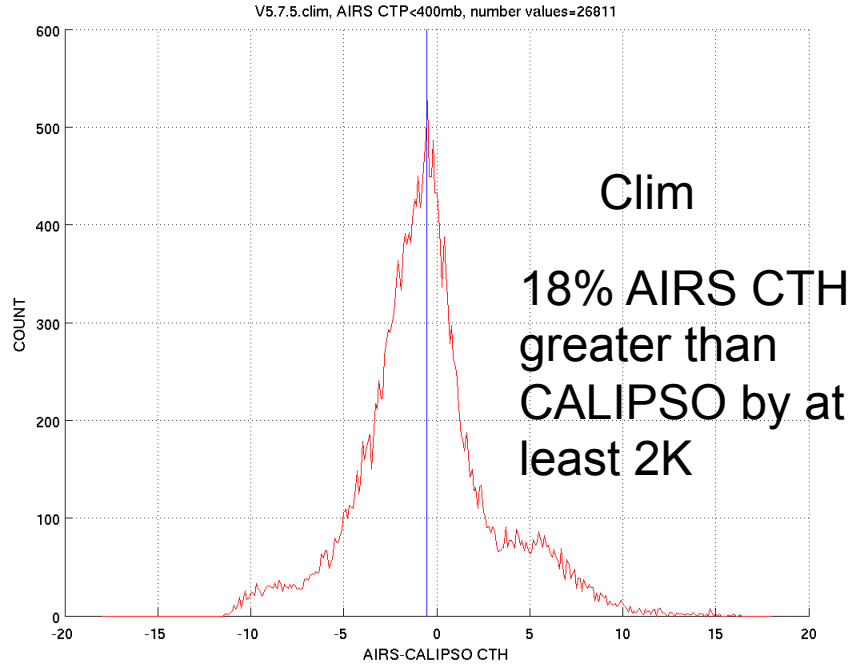
CALIPSO V3.1	V5.7.5 MODIS EMISSIVITY w/ HGWT=2.5						V5.7.5 SCCNN w/ HGWT=2.5					
	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)
CIRRUS	3036	0.67	1.51	2.13	2.61	1.63	3036	0.72	1.71	1.94	2.59	1.59
ALTOSTRATUS	4138	0.70	0.95	2.15	2.35	1.55	4140	0.73	1.23	2.01	2.36	1.50
ALTOCUMULUS	2203	0.71	0.88	3.27	3.39	2.39	2201	0.73	0.97	3.20	3.34	2.40
STRATOCUMULUS	9321	0.70	-0.64	3.23	3.30	2.23	9357	0.70	-0.35	3.24	3.25	2.26
CUMULUS	716	0.75	0.10	3.37	3.37	2.34	716	0.76	0.27	3.32	3.33	2.33
NIBOSTRATUS	5259	0.69	0.09	1.91	1.91	1.27	5276	0.68	0.55	1.92	2.00	1.29
DEEP CONVECTION	1156	0.29	3.09	3.57	4.72	3.24	1156	0.55	2.52	2.72	3.71	2.49

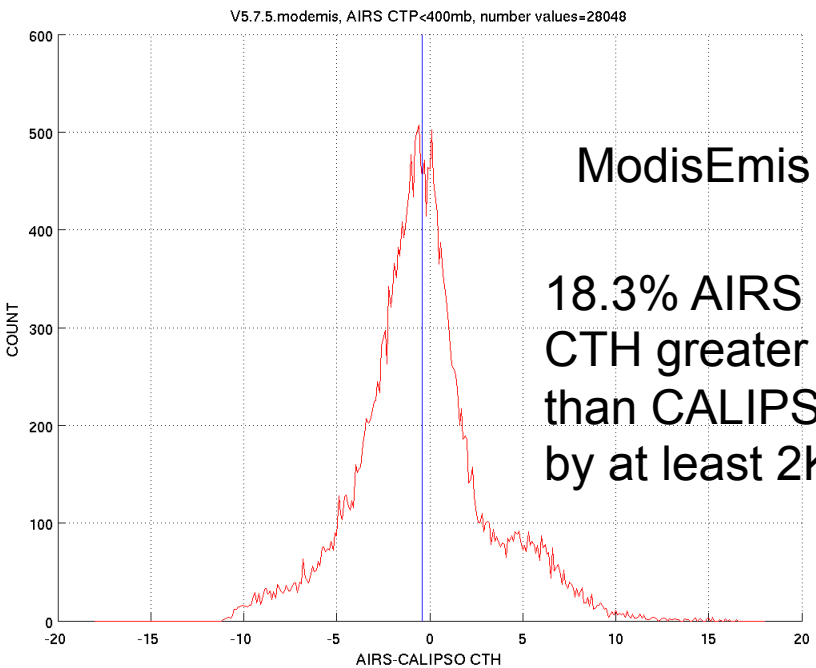
1/6/2007 &
1/30/2007

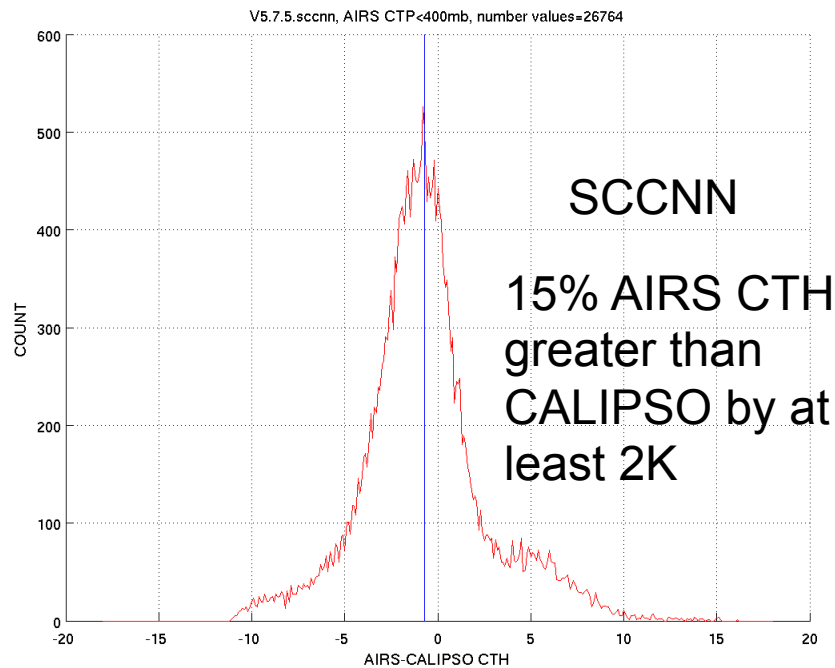
CloudSat R04	V5						V5.7.5 CLIMATOLOGY w/ HGWT=2.5					
	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)
CIRRUS	3019	0.81	0.57	1.27	1.39	0.92	3031	0.75	0.59	1.69	1.79	1.14
ALTOSTRATUS	4132	0.76	-0.05	1.60	1.60	1.02	4093	0.75	0.06	1.76	1.76	1.13
ALTOCUMULUS	2160	0.64	-1.15	2.59	2.84	2.14	2175	0.60	-1.34	2.94	3.24	2.48
STRATOCUMULUS	9196	0.49	-2.54	3.00	3.93	2.63	9428	0.53	-2.23	3.03	3.76	2.60
CUMULUS	644	0.63	-2.03	2.86	3.51	2.49	722	0.69	-1.94	2.81	3.41	2.40
NIBOSTRATUS	4774	0.62	-0.60	1.71	1.81	1.24	5178	0.60	-0.53	1.96	2.03	1.43
DEEP CONVECTION	596	0.74	0.33	1.85	1.88	1.38	1130	0.66	0.39	2.27	2.31	1.61

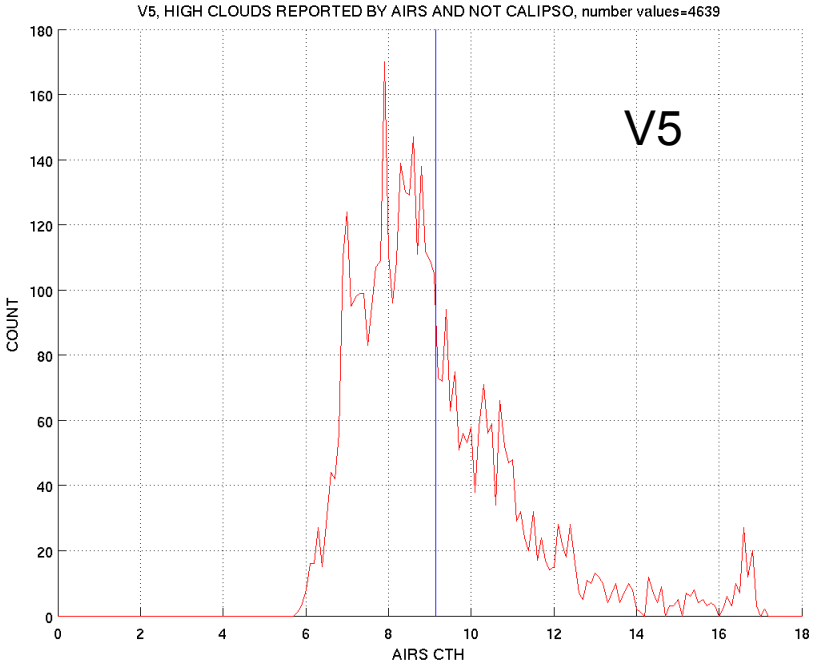
CloudSat R04	V5.7.5 MODIS EMISSIVITY w/ HGWT=2.5						V5.7.5 SCCNN w/ HGWT=2.5					
	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)	NUM VAL	COR R	AVG BIAS (km)	STD BIAS (km)	AVG RESID (km)	STD RESID (km)
CIRRUS	3037	0.73	0.29	1.69	1.71	1.10	3037	0.77	0.50	1.51	1.59	0.99
ALTOSTRATUS	4140	0.73	-0.19	1.81	1.82	1.19	4142	0.75	0.09	1.70	1.70	1.07
ALTOCUMULUS	2205	0.57	-1.46	2.96	3.30	2.48	2203	0.60	-1.37	2.91	3.21	2.46
STRATOCUMULUS	9469	0.53	-2.44	3.09	3.94	2.75	9502	0.53	-2.16	3.04	3.72	2.66
CUMULUS	722	0.68	-1.88	2.83	3.40	2.44	722	0.68	-1.72	2.83	3.31	2.40
NIBOSTRATUS	5260	0.60	-0.77	1.96	2.10	1.48	5277	0.62	-0.31	1.91	1.93	1.34
DEEP CONVECTION	1156	0.30	1.26	3.42	3.64	2.85	1156	0.52	0.70	2.70	2.79	2.10

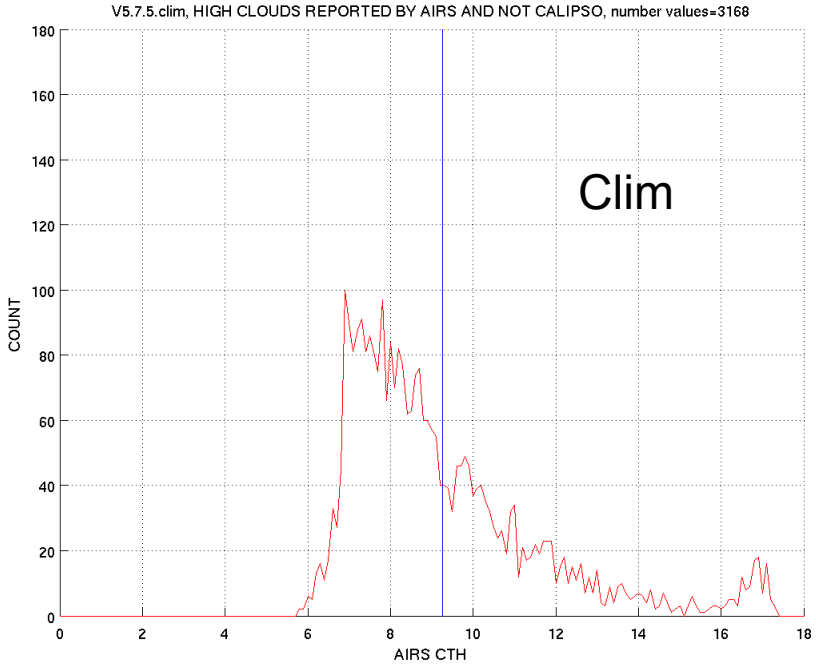

V5, AIRS CTP<400mb, number values=26712
V5
19% AIRS CTH greater than CALIPSO by at least 2K
COUNT
AIRS-CALIPSO CTH

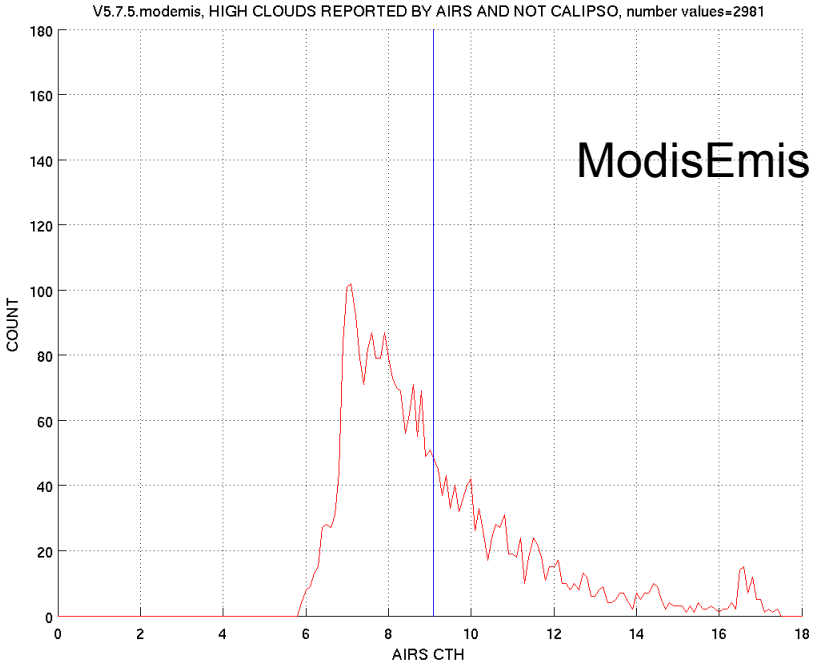

V5.7.5.clim, AIRS CTP<400mb, number values=26811
Clim
18% AIRS CTH greater than CALIPSO by at least 2K
COUNT
AIRS-CALIPSO CTH

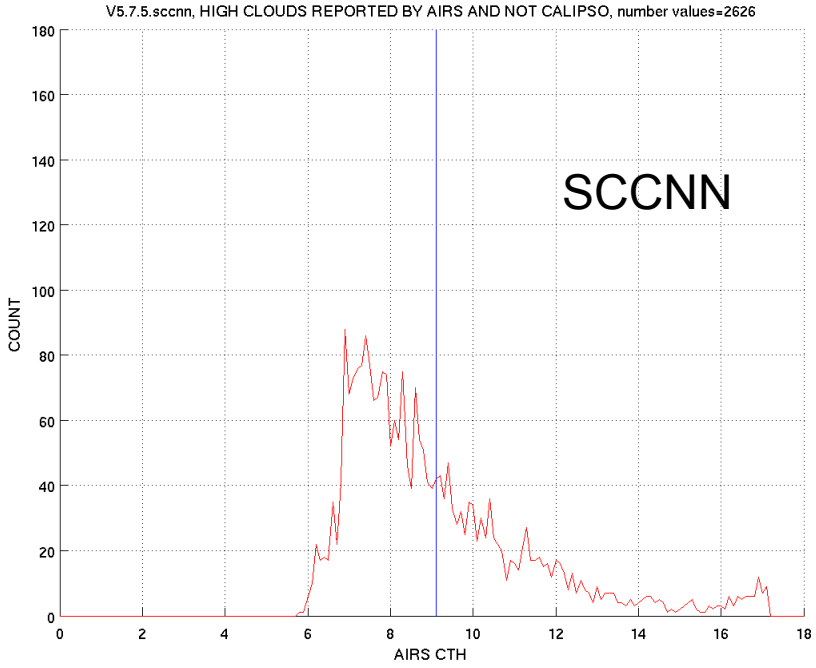

V5.7.5.modemis, AIRS CTP<400mb, number values=28048
ModisEmis
18.3% AIRS CTH greater than CALIPSO by at least 2K
COUNT
AIRS-CALIPSO CTH

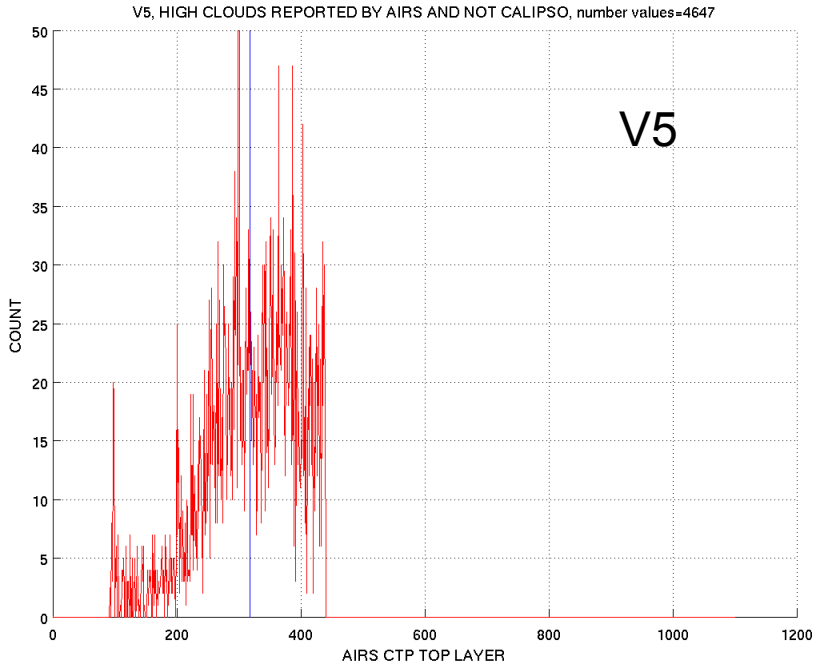

V5.7.5.sccnn, AIRS CTP<400mb, number values=26764
SCCNN
15% AIRS CTH greater than CALIPSO by at least 2K
COUNT
AIRS-CALIPSO CTH

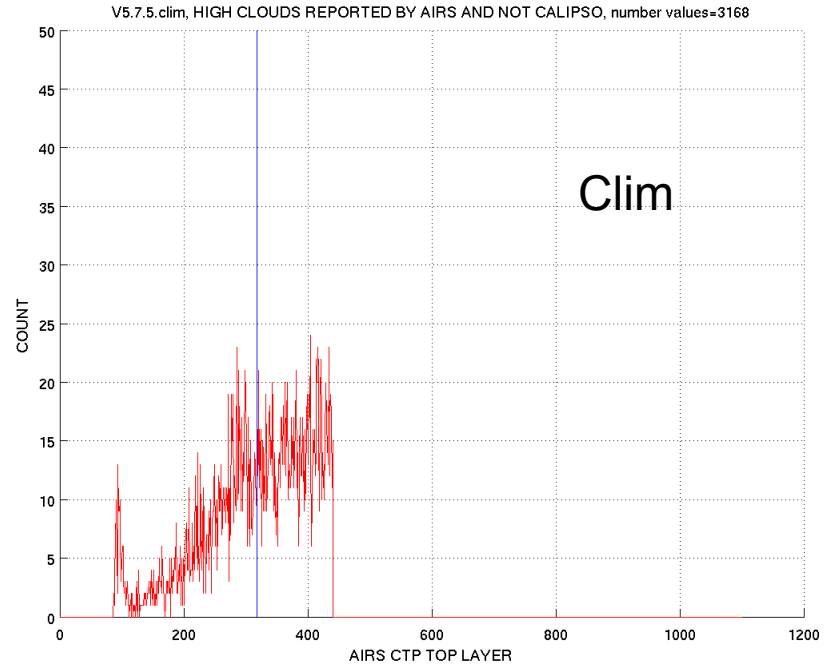

V5, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=4639
V5
COUNT
AIRS CTH

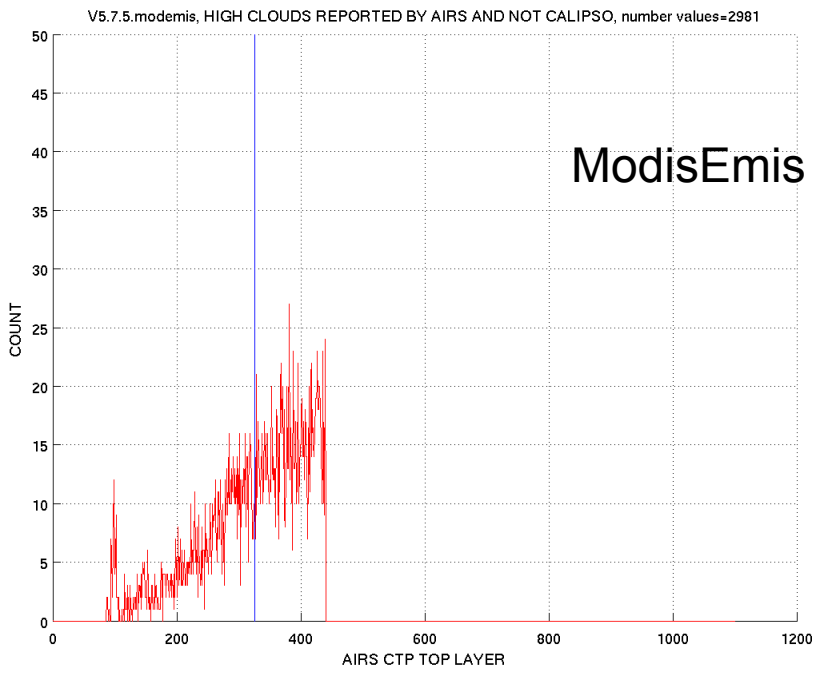

V5.7.5.clim, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=3168
Clim
COUNT
AIRS CTH

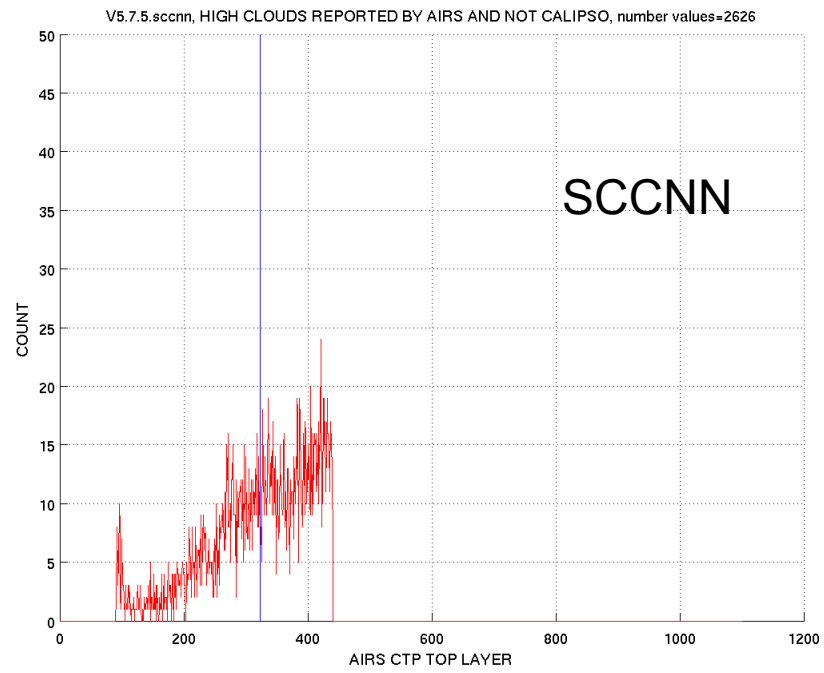

V5.7.5.modemis, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=2981
ModisEmis
COUNT
AIRS CTH


V5.7.5.sccnn, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=2626
SCCNN
COUNT
AIRS CTH


V5, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=4647
V5
COUNT
AIRS CTP TOP LAYER


V5.7.5.clim, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=3168
Clim
COUNT
AIRS CTP TOP LAYER


V5.7.5.modemis, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=2981
ModisEmis
COUNT
AIRS CTP TOP LAYER


V5.7.5.sccnn, HIGH CLOUDS REPORTED BY AIRS AND NOT CALIPSO, number values=2626
SCCNN
COUNT
AIRS CTP TOP LAYER

Findings:

1. SCCNN is more radiatively consistent in its retrievals than the MODIS EMISSIVITY and the CLIMATOLOGY versions, although not as good as V5. Radiative consistency does not take into account water vapor correction and so it is only good for very large errors or for where there is a reported clear sky field of view.

2. The global increase in effective cloud coverage from year to year in V5 is almost non-existent in SCCNN.

3. SCCNN in general compares better than V5 and all versions of candidate V6 to CALIPSO and CloudSat cloud top height.