AIRS Clear Detection Flag

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Objectives

- Provide information indicating if fov is clear with a confidence indicator.
- If not clear:
  - provide cloud amount and height.
  - indicate channels not affected by clouds
- Required for validation campaigns
- Required by NWP centers

Clear Detection – Combination of 3 tests

- AMSU channels 4, 5 and 6 are used to predict AIRS channel at 2390.9 cm-1.

*Predicted AIRS at 2390.9 = 11.327-.185*amsu4+1.930*amsu5-*
*0.777*amsu6+1.048*csza-4.243*(1.-cang)*

where csza = cosine solar zenith angle

cang = cosine view angle (scan angle)

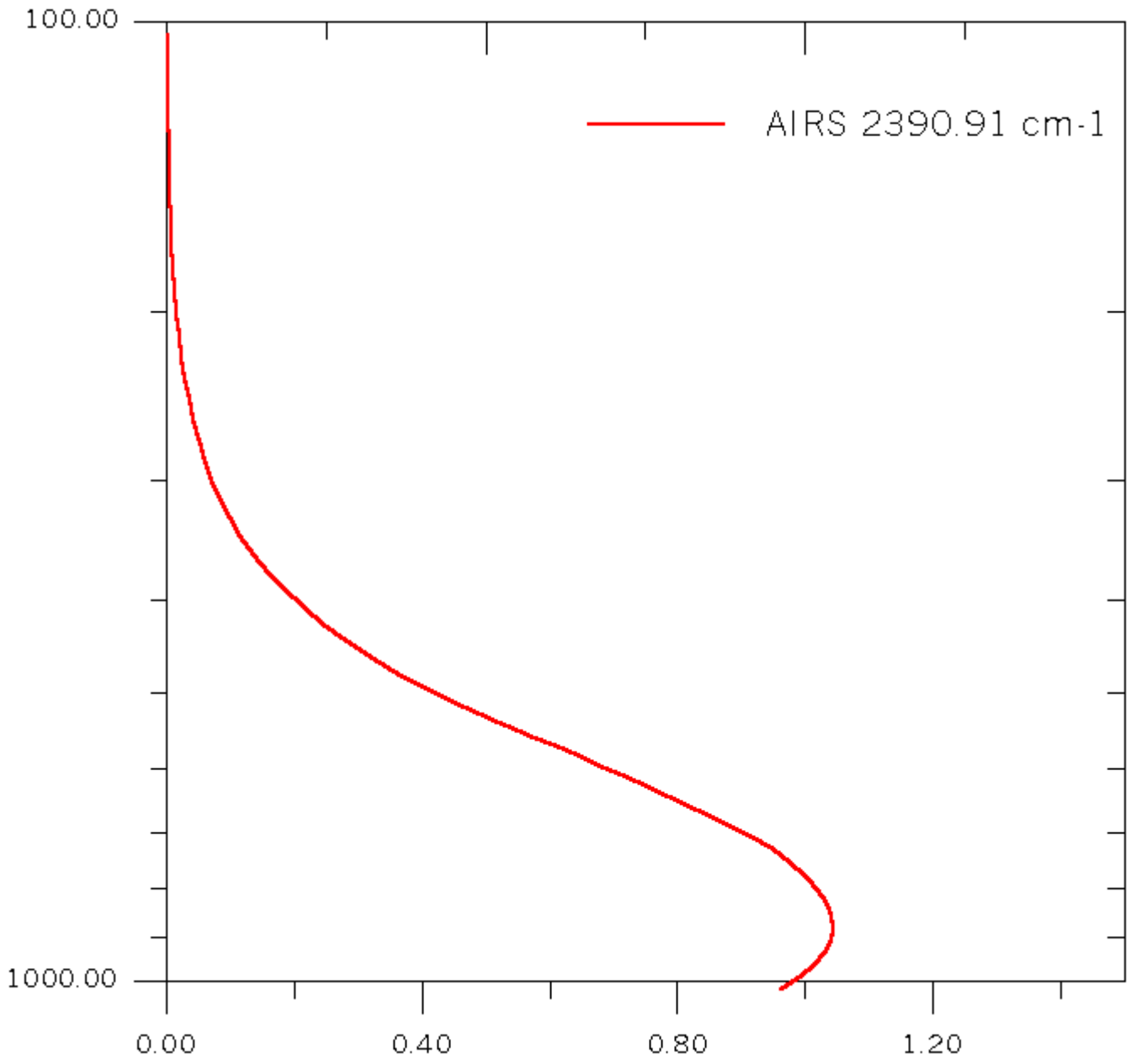
amsu4 = amsu channel 4 brightness temperature , etc

- FOV is labeled "mostly clear" if predicted AIRS – observed AIRS < 2

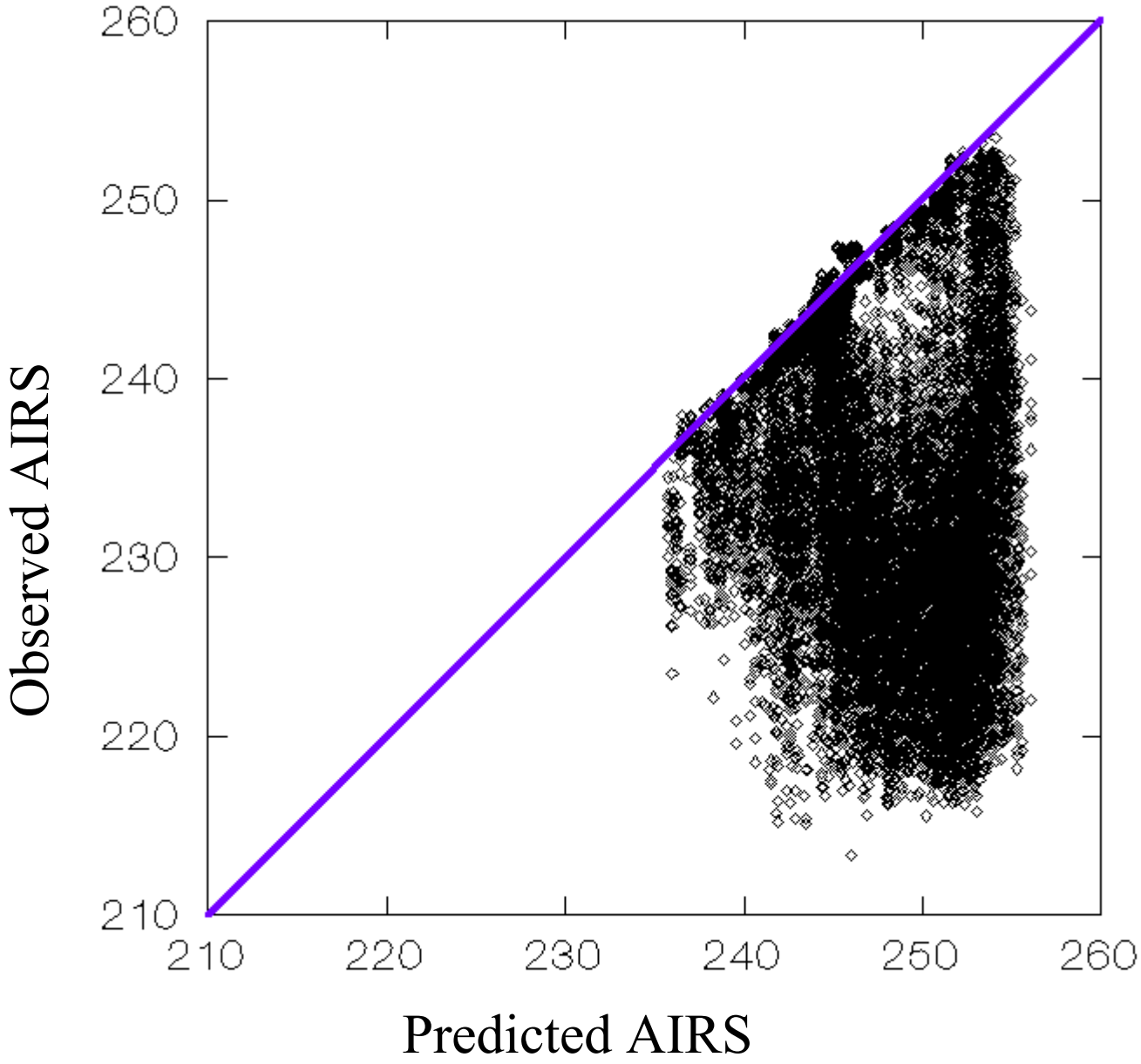
  AND IF

- Split IR window test is successful
- Variability of 2390.910 radiance within 3x3 is low

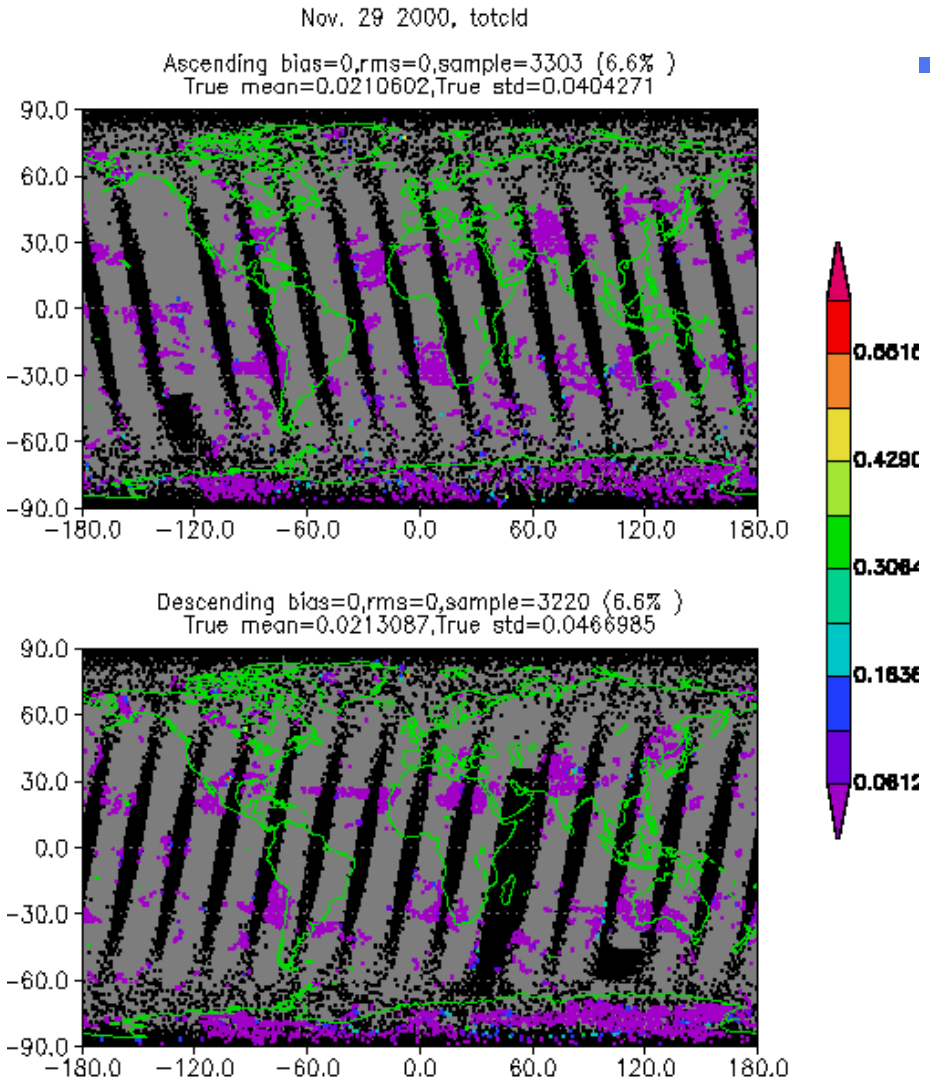
AIRS 2390.91 Weighting functions



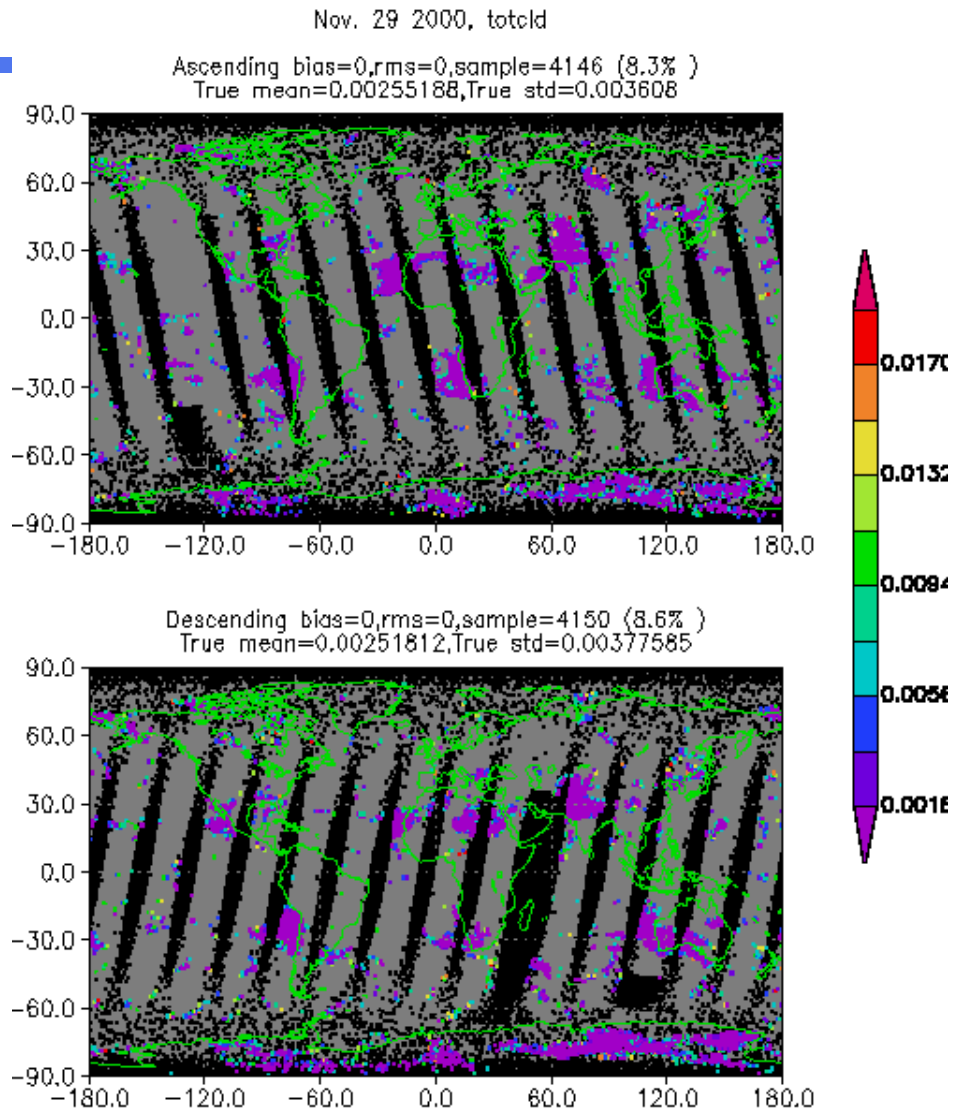
Predict AIRS from AMSU test



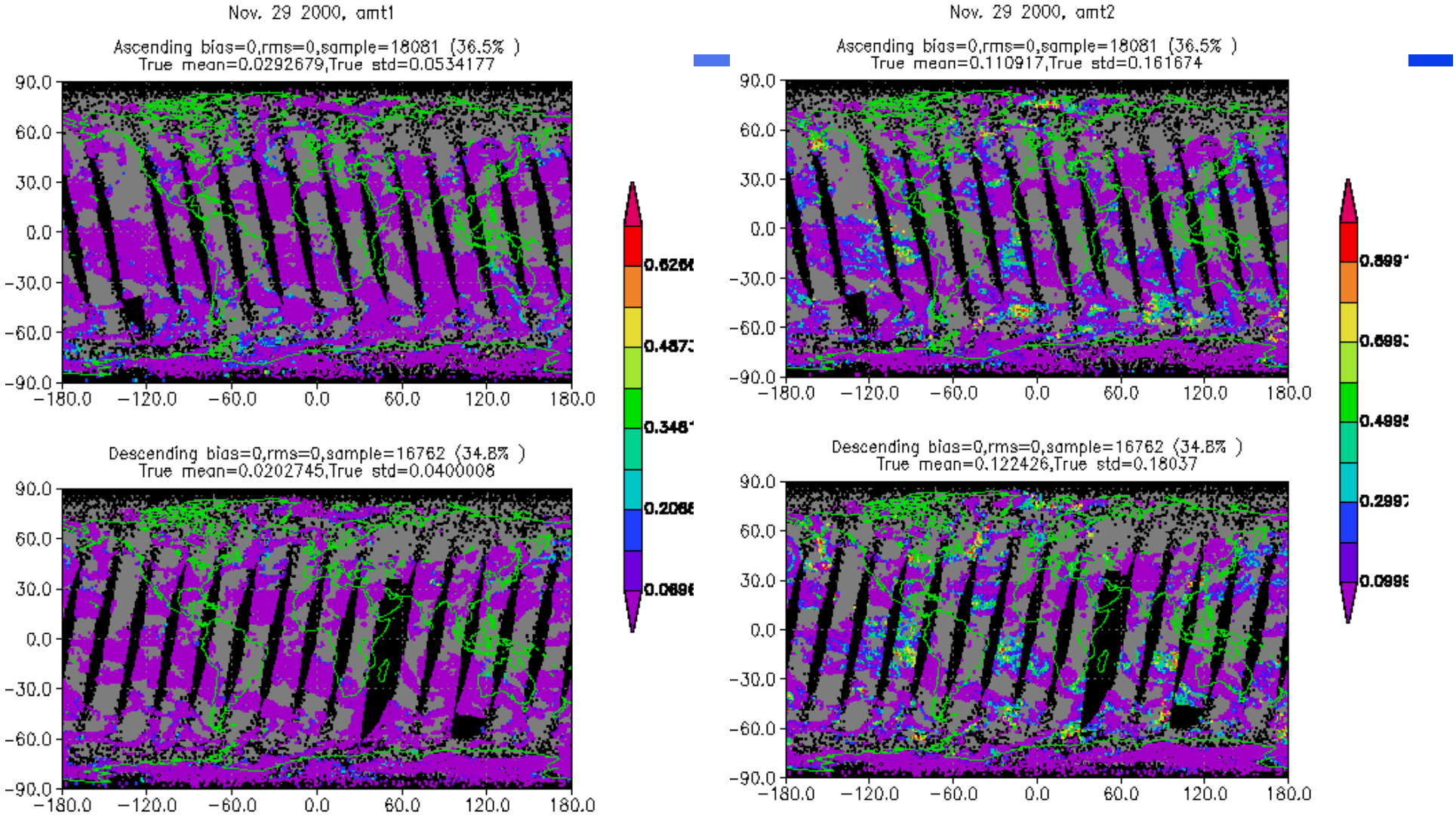
Total cloud (3 tests)

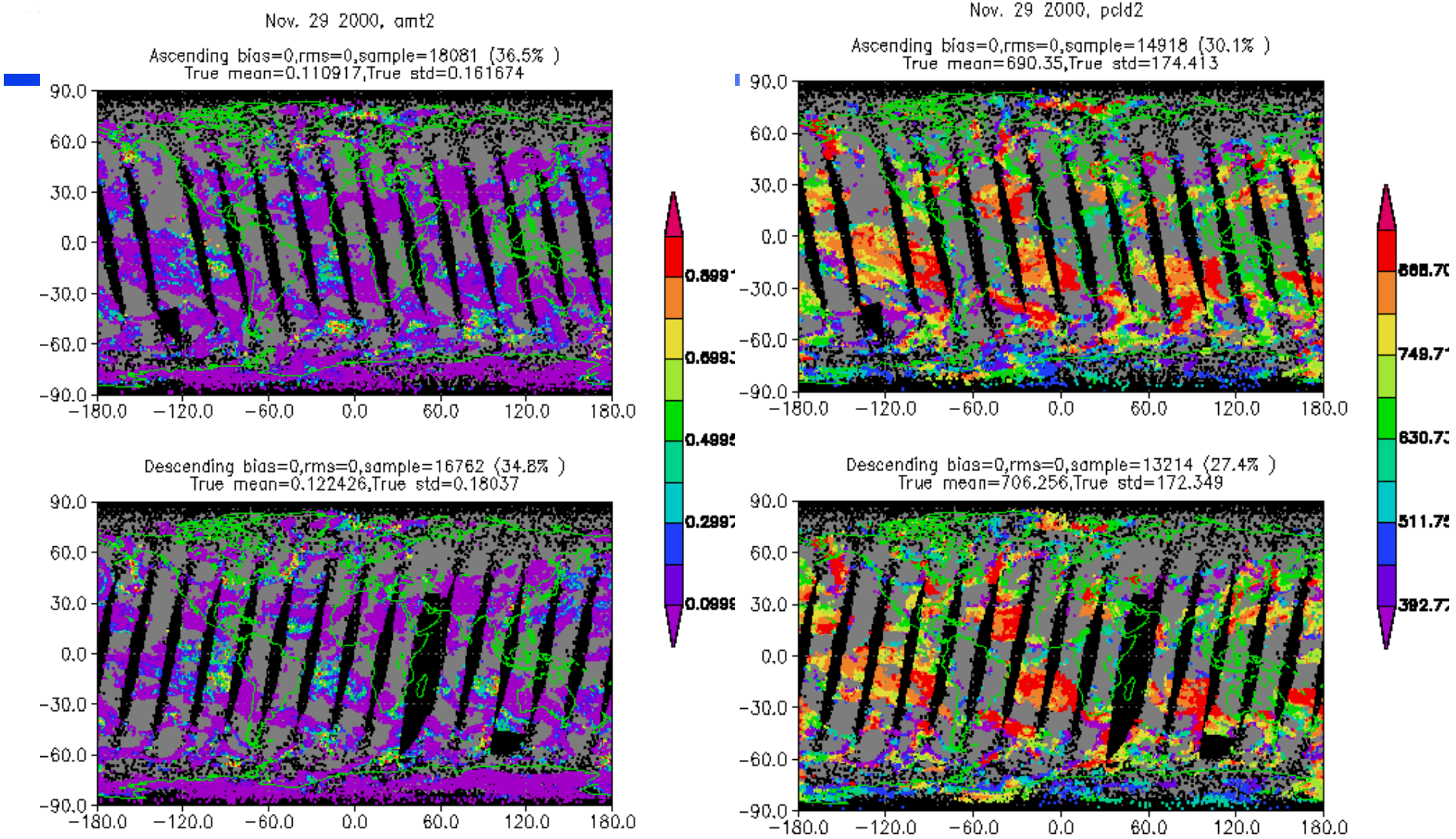


True clear (< .02%)

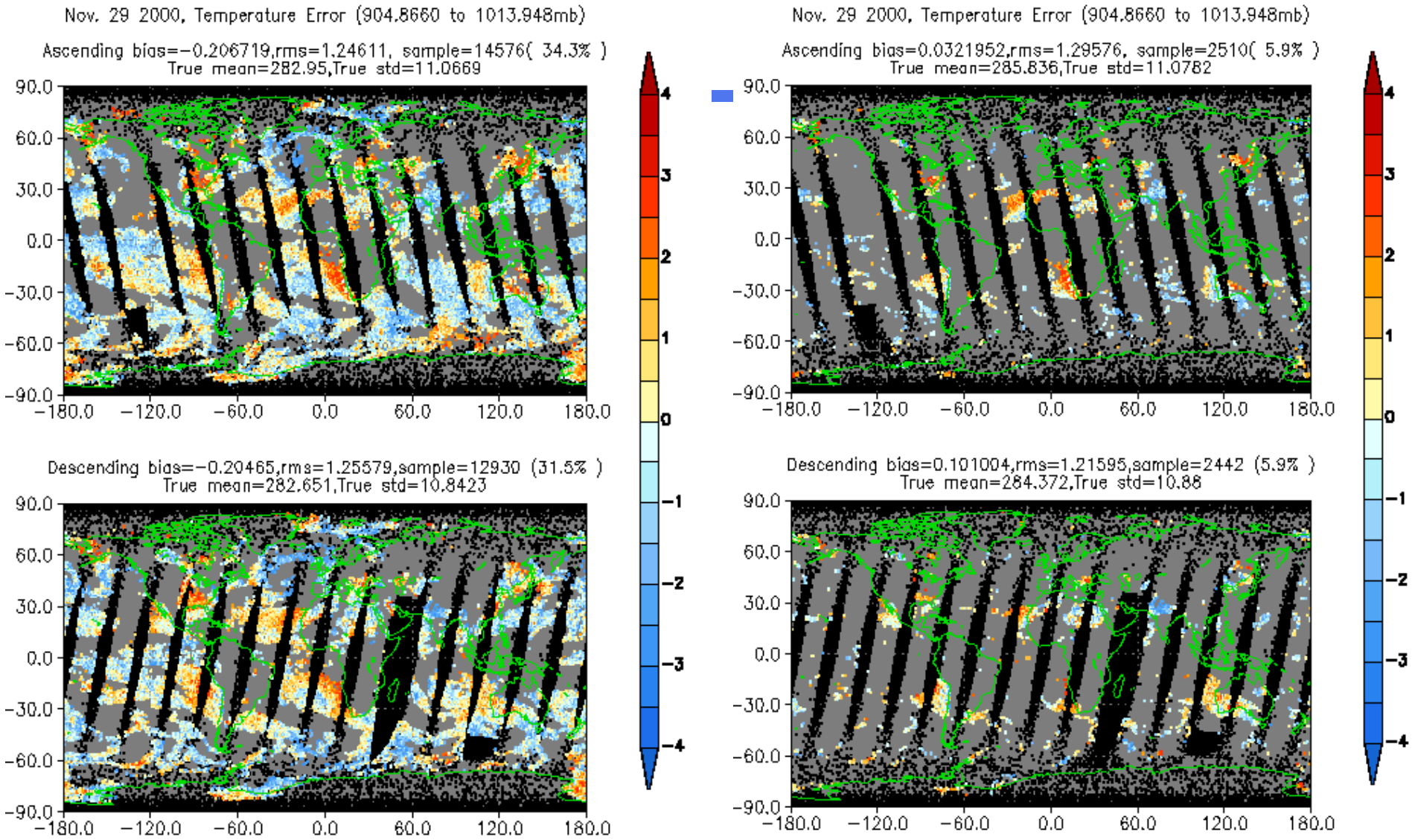


AMSU test only ; diff < 2 & SW-LW < 20




Nov. 29 2000, amt2
Ascending bias=0,rms=0,sample=18081 (36.5%)
True mean=0.110917,True std=0.161674
Descending bias=0,rms=0,sample=16762 (34.8%)
True mean=0.122426,True std=0.18037
Nov. 29 2000, pcld2
Ascending bias=0,rms=0,sample=14918 (30.1%)
True mean=690.35,True std=174.413
Descending bias=0,rms=0,sample=13214 (27.4%)
True mean=706.256,True std=172.349
90.0
60.0
30.0
0.0
-30.0
-60.0
-90.0
-180.0
-120.0
-60.0
0.0
60.0
120.0
180.0
0.4995
0.2997
0.0998
749.7
630.7
511.7
392.7

Regression retrieval is insensitive to low clouds

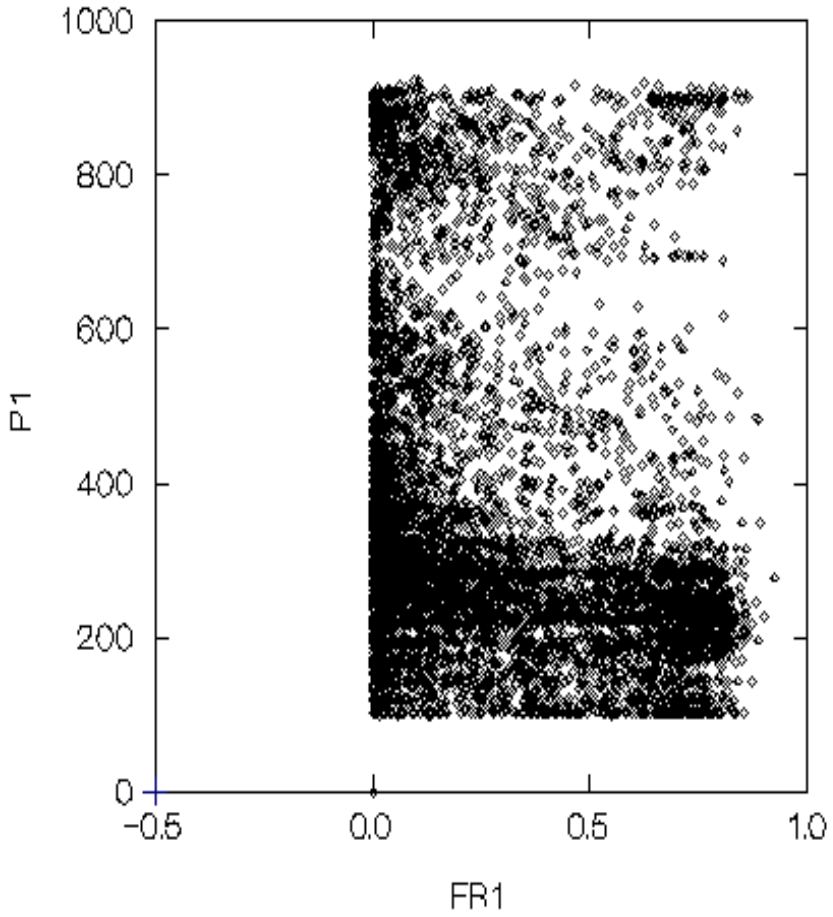


Team Exercise

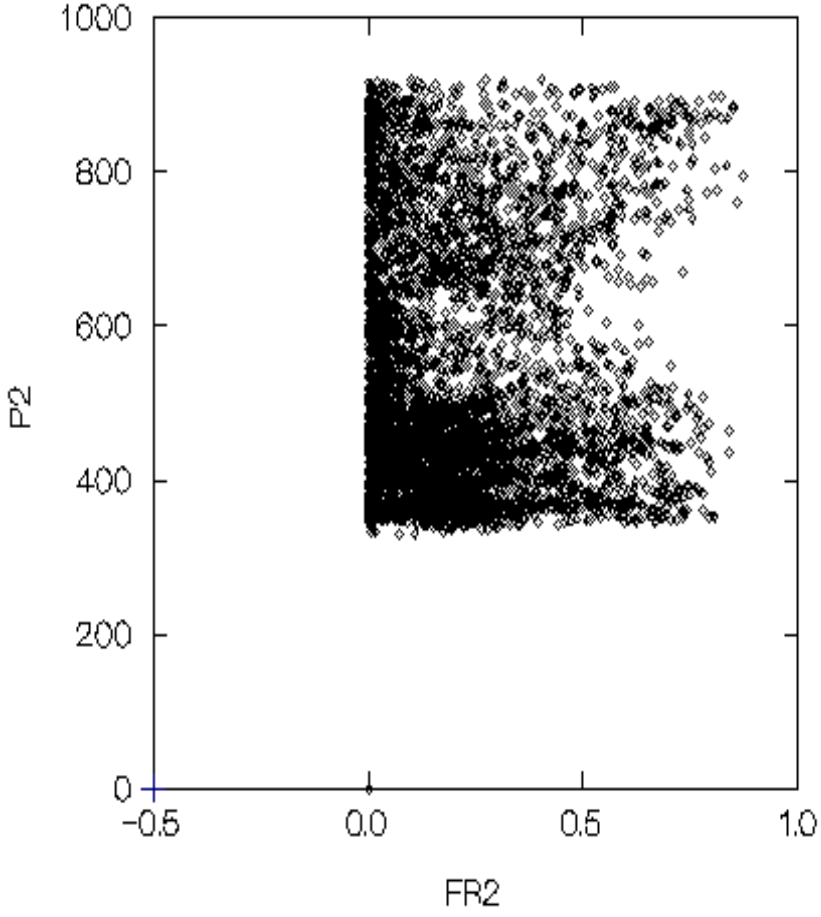
- Cloud detection (clear detection) algorithm was inserted in beginning of PGE code
- Completely independent of RTA.
- Tested on Granule 401 – 7200 cases, first scanline of the 240 granules.

ALL DATA - GRANULE 401 SAMPLE SIZE=7200

Mean = 28.2% , SDV = 27%



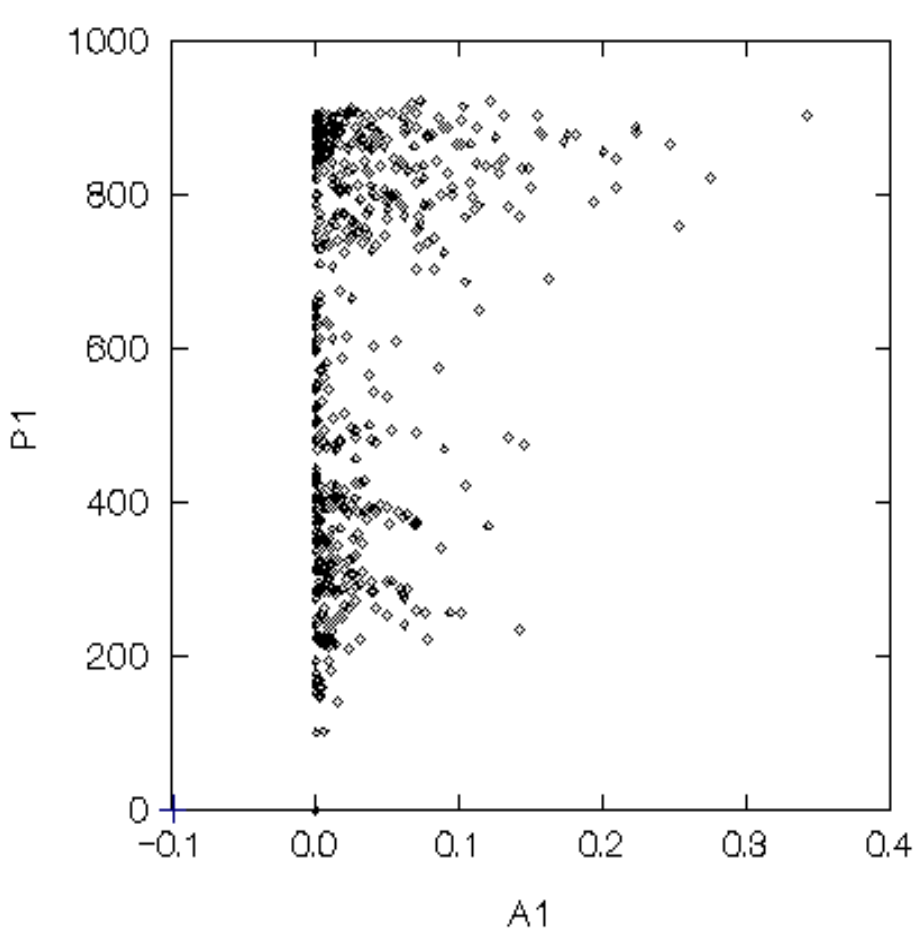
Mean = 16.3% , SDV = 18.7%



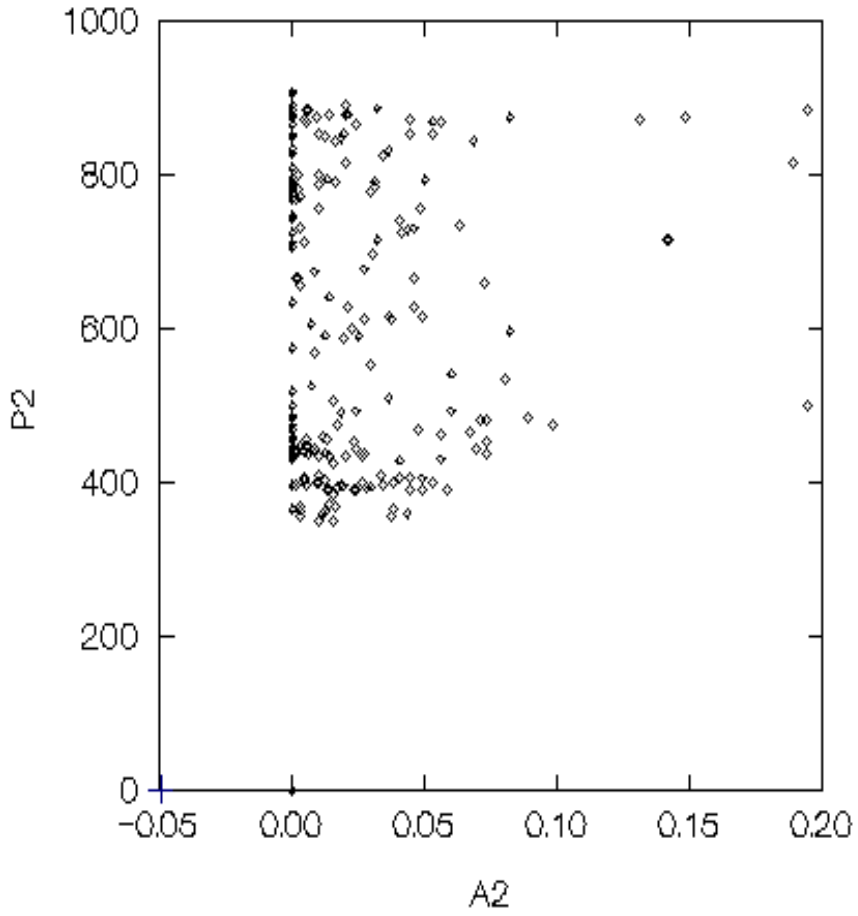
Predicted AIR – Observed < 1.67 ; Coherence < .0026, SWLW < 7

SAMPLE SIZE = 712 Successful Cases = 367

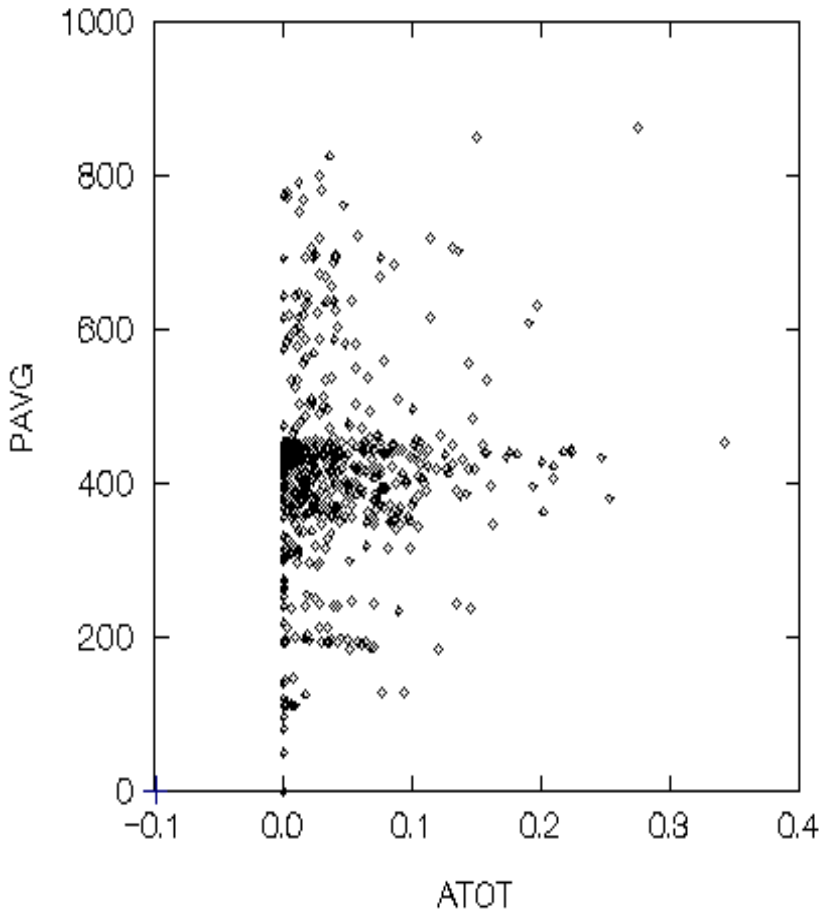
Mean = 2.6% , SDV = 4.3%

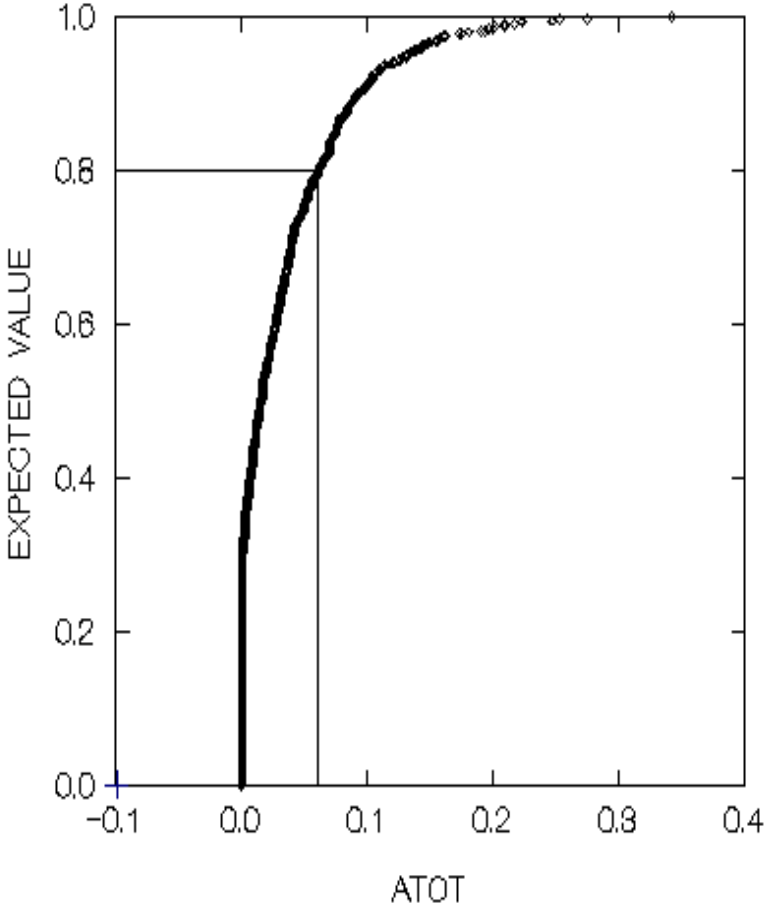


Mean = 0.8% , SDV = 2.2%

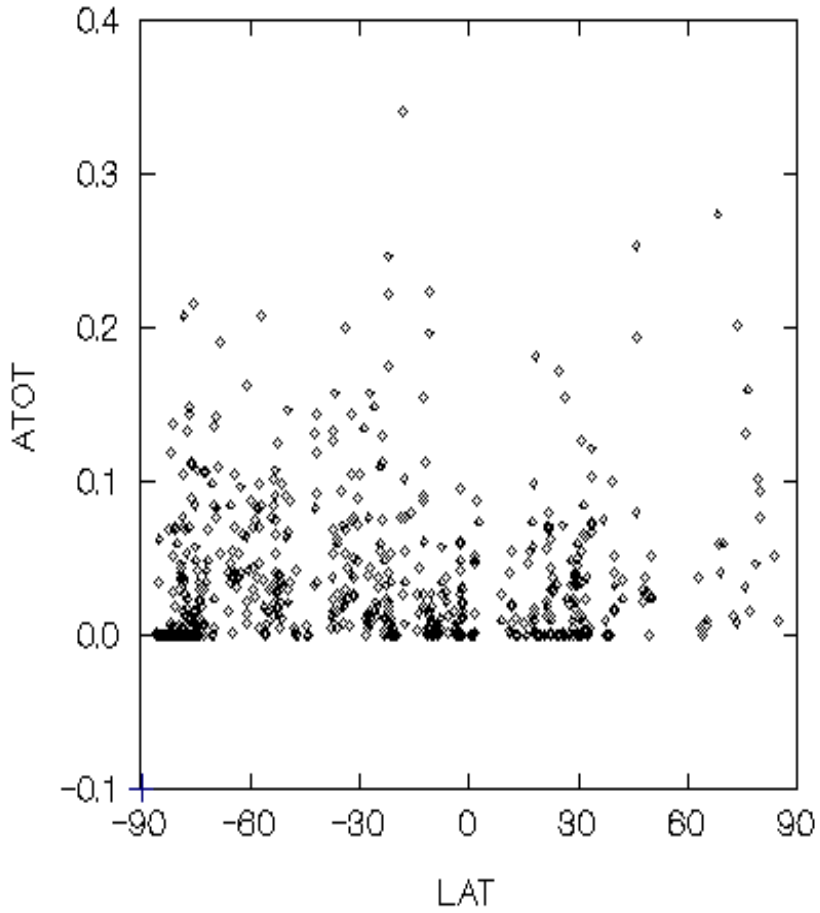


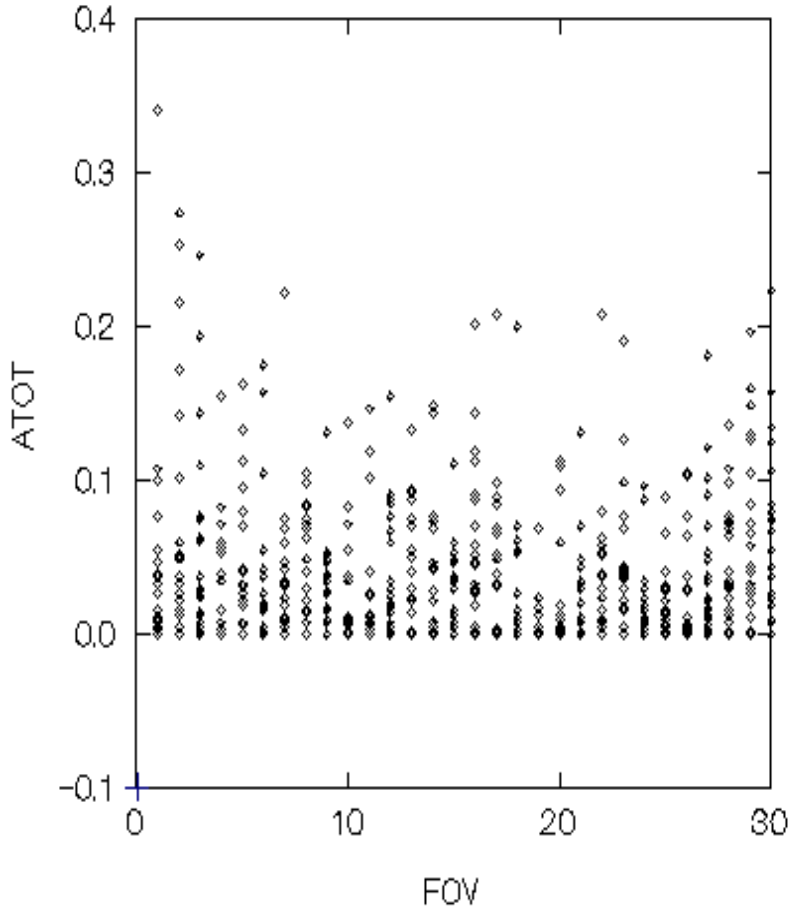
Total cloud fraction



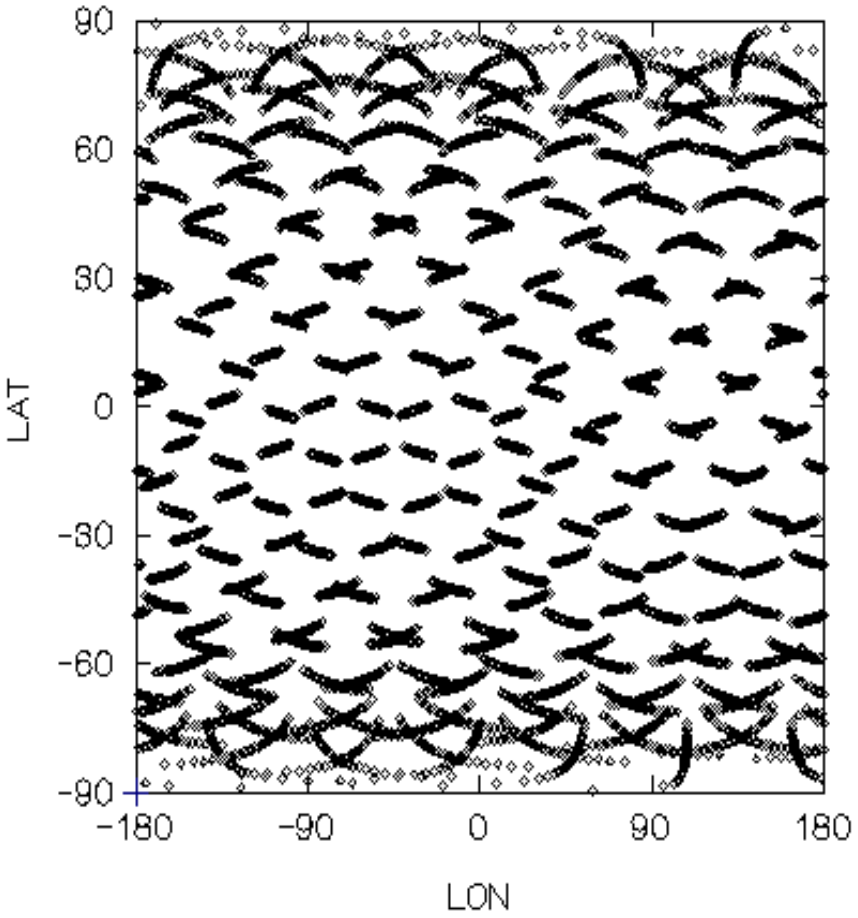


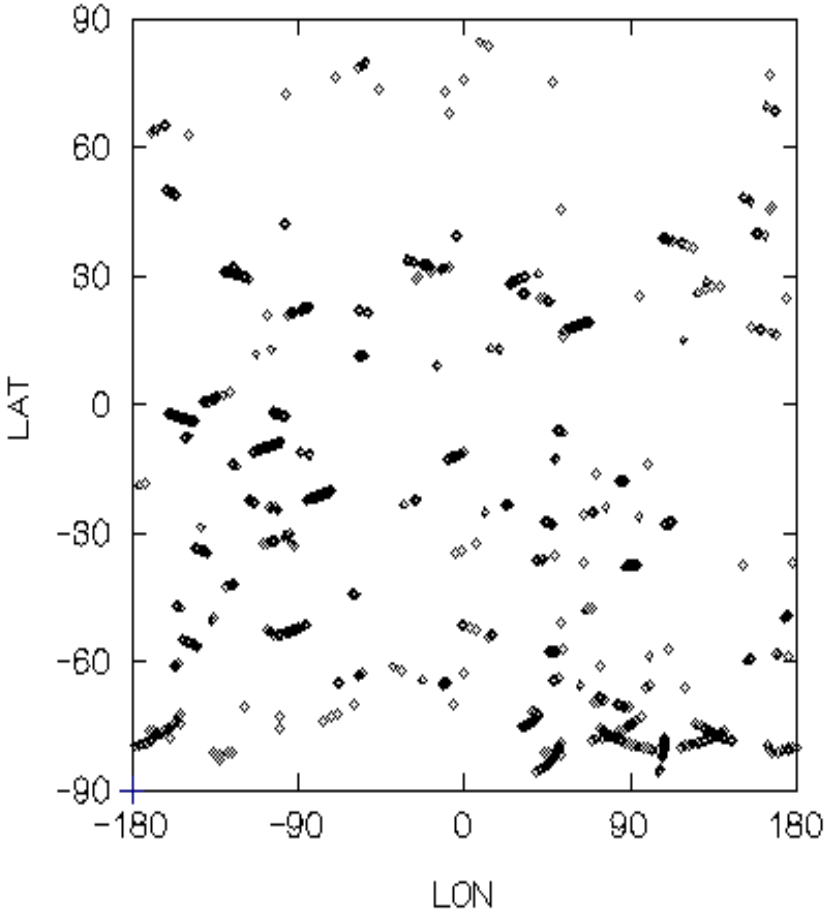
Total cloud fraction vs Latitude and FOV



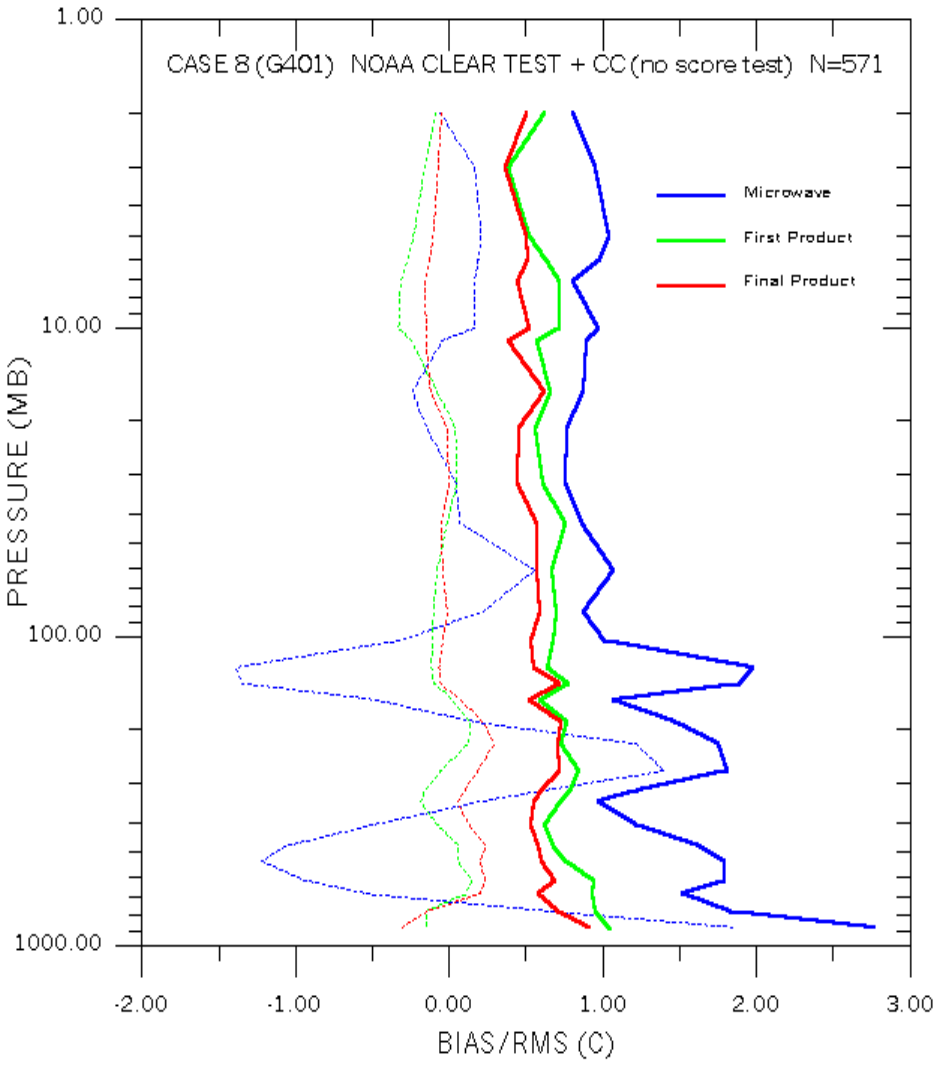


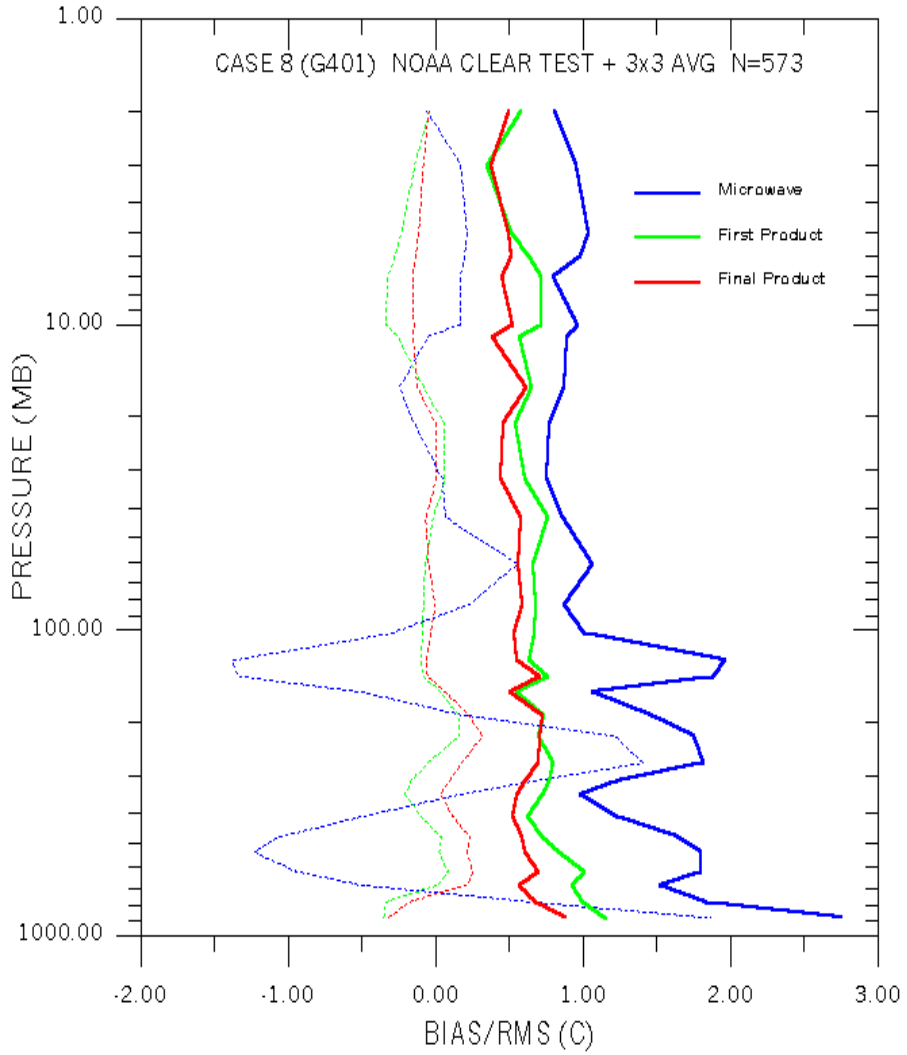
All locations vs. "clear" locations





Science Team Exercise -Granule 401



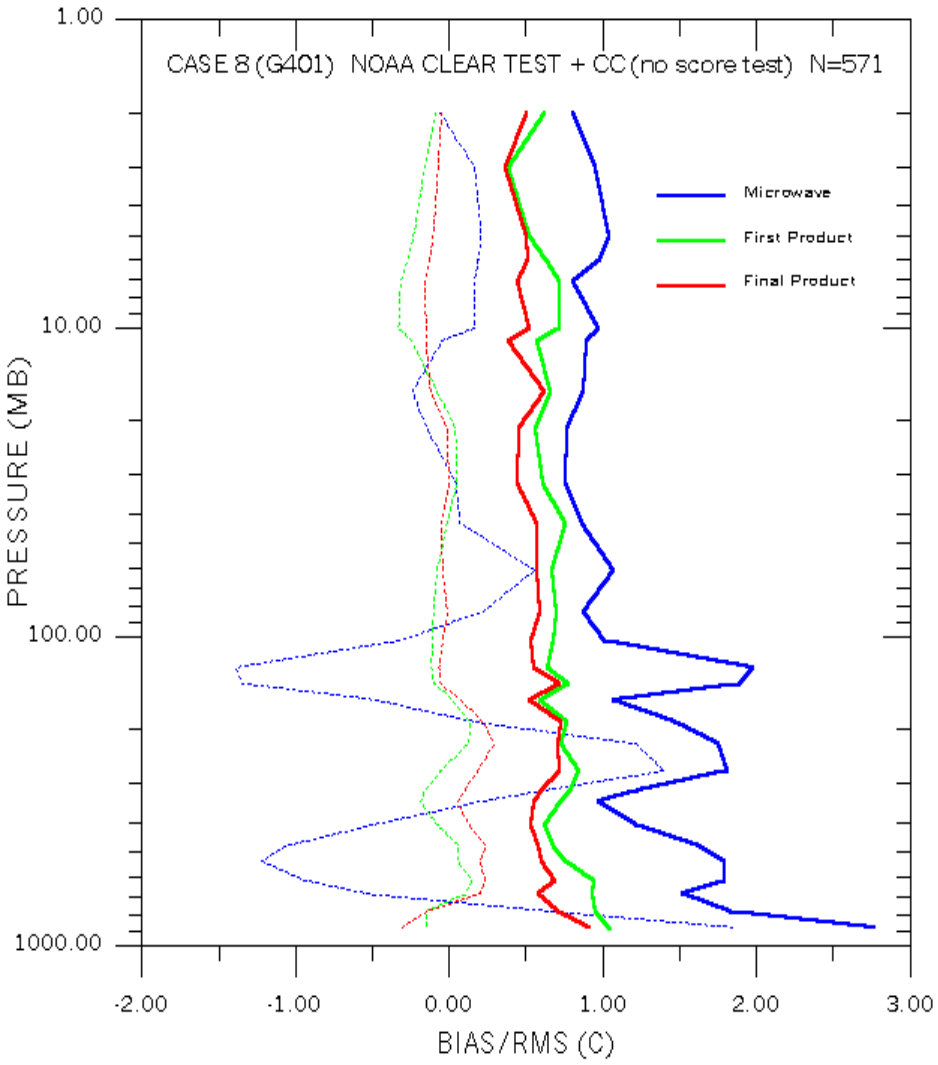


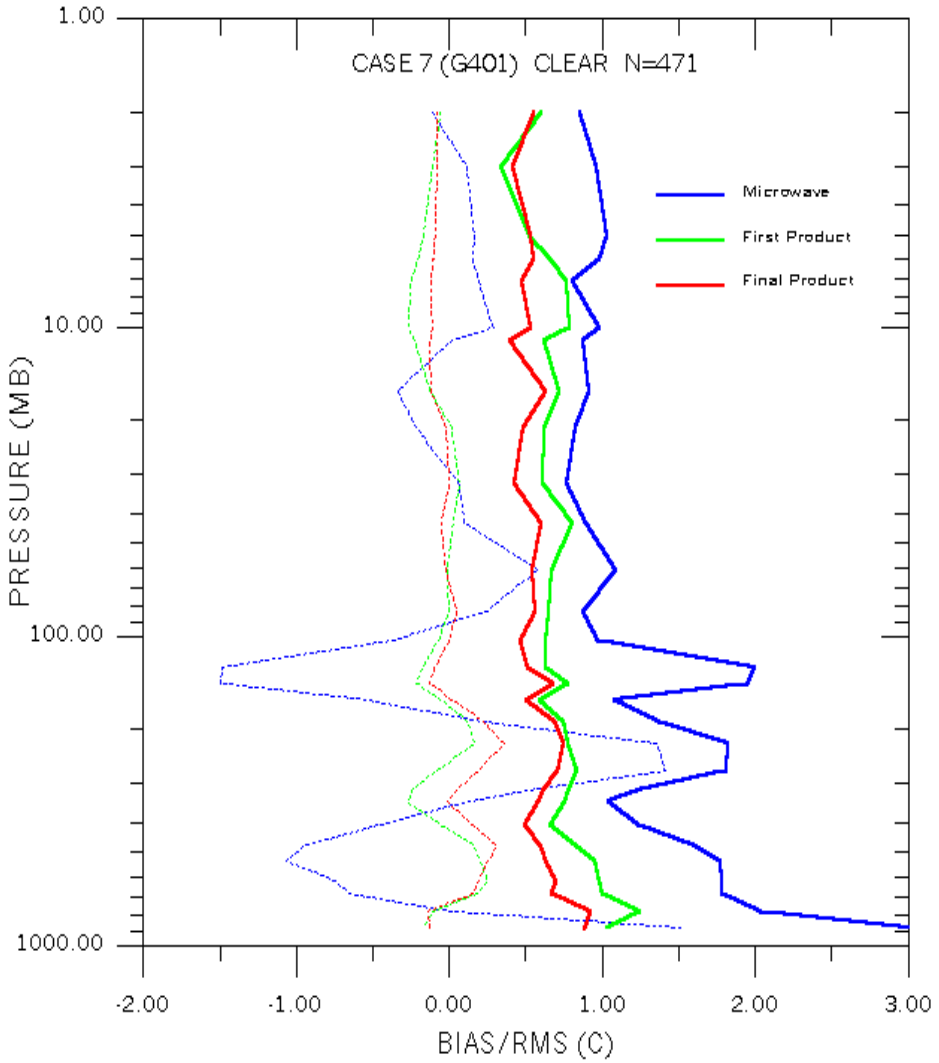
NOAA CLEAR DETECTION + INITIAL CLOUD CLEARING + FINAL CC
SURFACE TEMPERATURE RETRIEVAL STATISTICS (unit = Kelvin)

	Comparison		MW Retrieval			First Retrieval			Final Retrieval		
	mean	nn	bias	rms	nn	bias	rms	nn	bias	rms	nn
T_surf	280.118	571	-0.092	2.284	571	-0.429	0.926	571	-0.308	0.540	571
618.- 684.	268.296	531	-0.945	1.791	531	0.146	0.945	531	0.232	0.689	531
684.- 778.	275.275	483	-0.522	1.518	483	0.109	0.938	483	0.199	0.584	483
778.- 879.	280.306	475	0.642	1.836	475	-0.151	0.956	475	-0.142	0.708	475
879.-1100.	285.264	464	1.863	2.758	463	-0.151	1.041	463	-0.306	0.905	463
103.-1100.	troposphere		-0.104	1.609		-0.030	0.782		0.081	0.641	
T_total			0.628	1.944		0.014	0.705		0.039	0.636	

NOAA CLEAR DETECTION + 3X3 AVERAGING (NO INITIAL CLOUDING) + FINAL CC
SURFACE TEMPERATURE RETRIEVAL STATISTICS (unit = Kelvin)

	Comparison		MW Retrieval			First Retrieval			Final Retrieval		
	mean	nn	bias	rms	nn	bias	rms	nn	bias	rms	nn
_surf	279.944	573	-0.084	2.274	573	-0.632	1.177	573	-0.304	0.536	573
618.- 684.	268.176	533	-0.953	1.796	533	0.085	1.006	533	0.250	0.696	533
684.- 778.	275.166	484	-0.521	1.521	484	0.012	0.932	484	0.211	0.572	484
778.- 879.	280.248	475	0.640	1.833	475	-0.338	1.004	475	-0.181	0.681	475
879.-1100.	285.206	464	1.867	2.747	464	-0.355	1.148	464	-0.318	0.875	464
103.-1100.	troposphere		-0.104	1.609		-0.063	0.789		0.079	0.632	
T_total			0.628	1.942		-0.006	0.685		0.026	0.626	


CASE 8 (G401) NOAA CLEAR TEST + CC (no score test) N=571
Microwave
First Product
Final Product
PRESSURE (MB)
1.00
10.00
100.00
1000.00
-2.00
-1.00
0.00
1.00
2.00
3.00
BIAS/RMS (C)


CASE 7 (G401) CLEAR N=471
Microwave
First Product
Final Product
PRESSURE (MB)
1.00
10.00
100.00
1000.00
-2.00
-1.00
0.00
1.00
2.00
3.00
BIAS/RMS (C)

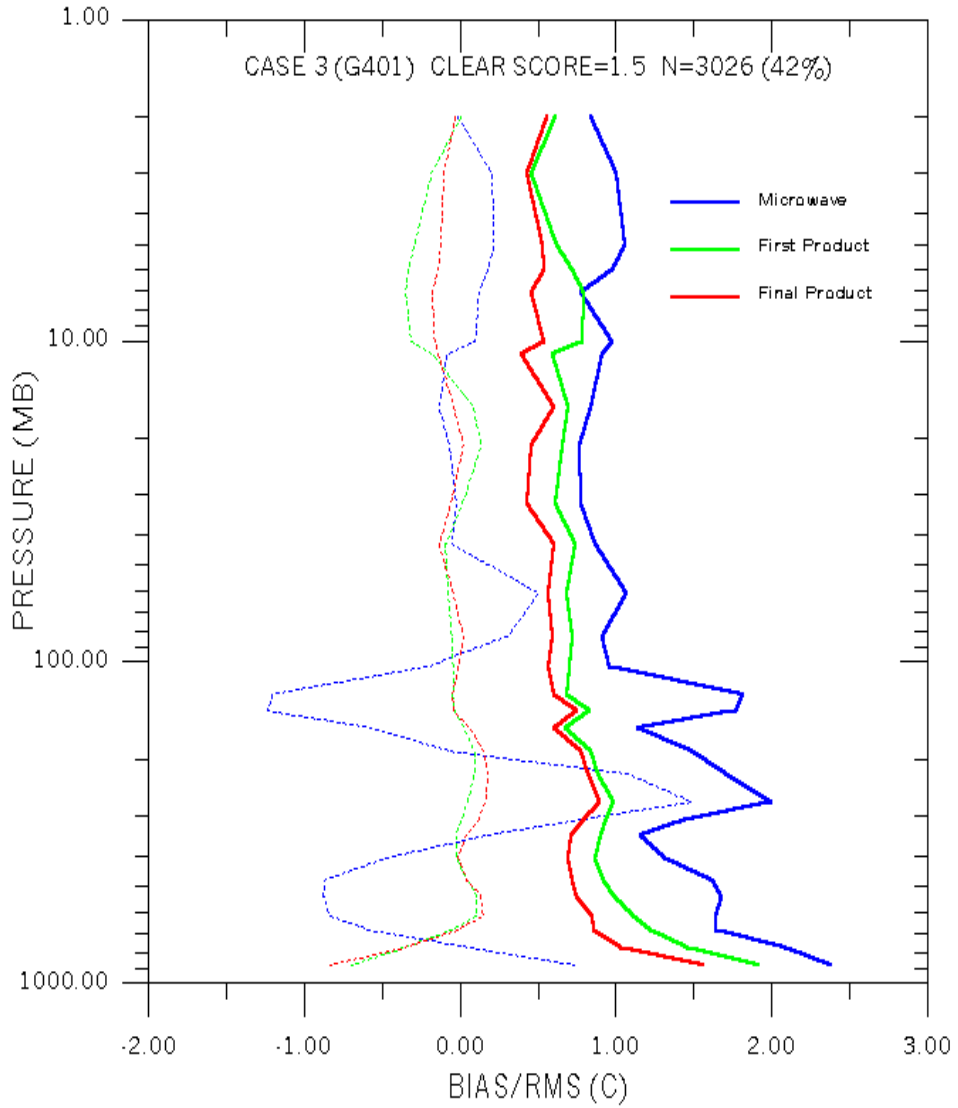
NOAA CLEAR DETECTION + INITIAL CLOUD CLEARING + FINAL CC (MODIFIED CASE-8)
SURFACE TEMPERATURE RETRIEVAL STATISTICS (unit = Kelvin)

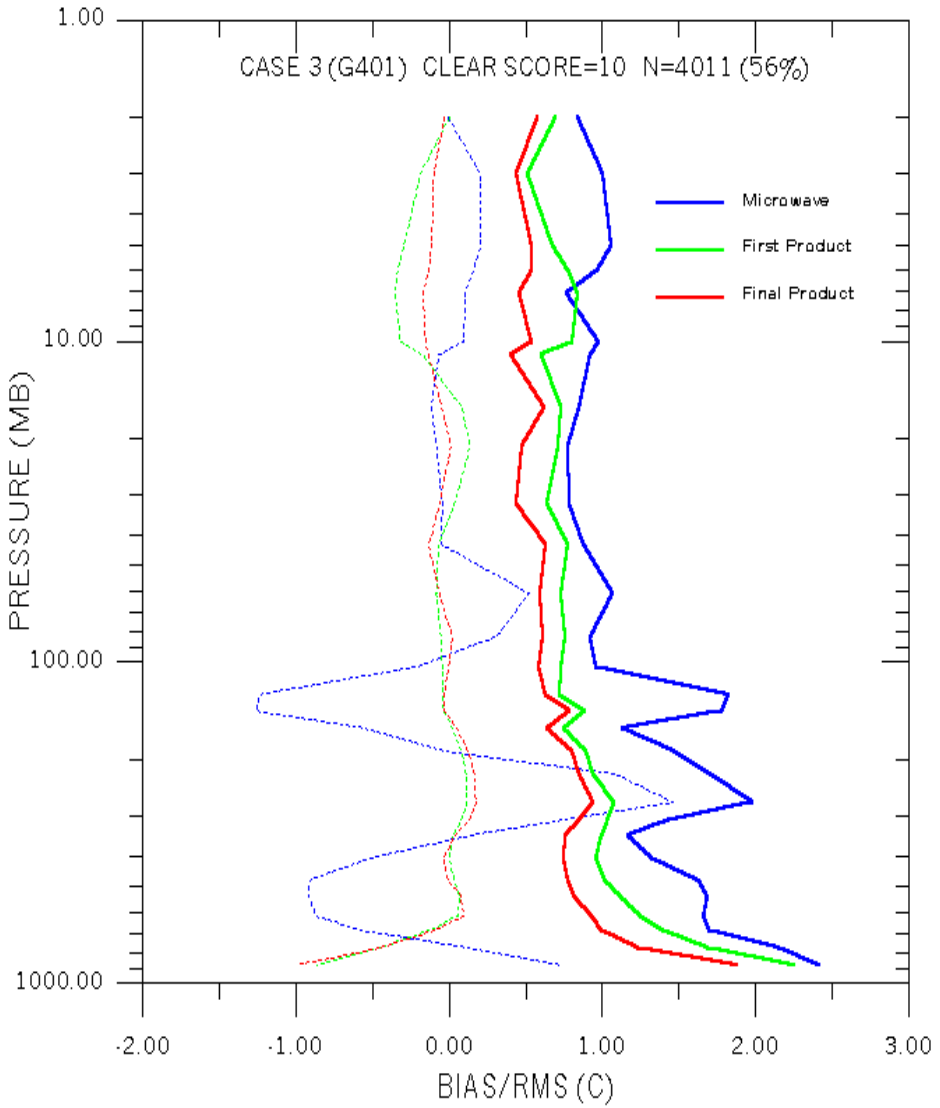
	Comparison		MW Retrieval			First Retrieval			Final Retrieval		
	mean	nn	bias	rms	nn	bias	rms	nn	bias	rms	nn
T_surf	280.118	571	-0.092	2.284	571	-0.429	0.926	571	-0.308	0.540	571
618.- 684.	268.296	531	-0.945	1.791	531	0.146	0.945	531	0.232	0.689	531
684.- 778.	275.275	483	-0.522	1.518	483	0.109	0.938	483	0.199	0.584	483
778.- 879.	280.306	475	0.642	1.836	475	-0.151	0.956	475	-0.142	0.708	475
879.-1100.	285.264	464	1.863	2.758	463	-0.151	1.041	463	-0.306	0.905	463
103.-1100.	troposphere		-0.104	1.609		-0.030	0.782		0.081	0.641	
T_total			0.628	1.944		0.014	0.705		0.039	0.636	

CASE-7 TRUE CLEAR
SURFACE TEMPERATURE RETRIEVAL STATISTICS (unit = Kelvin)

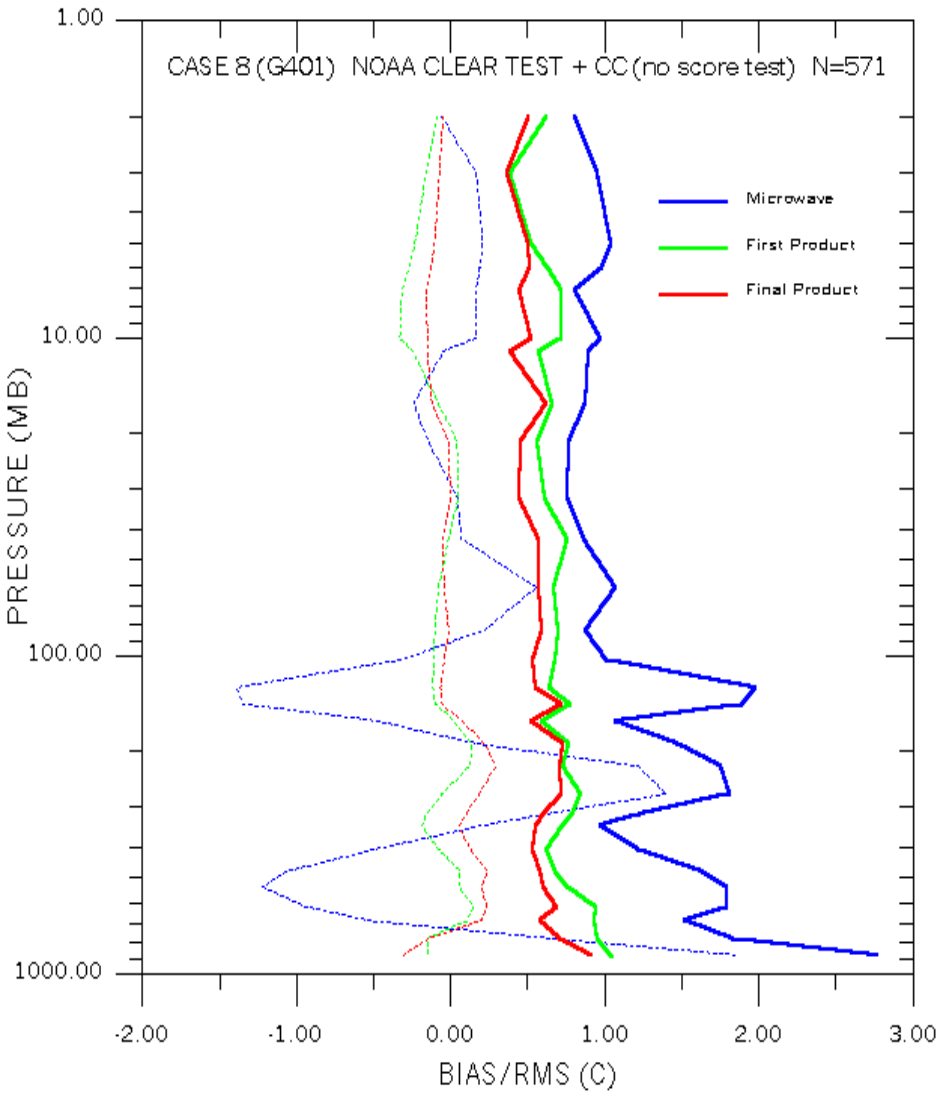
	Comparison		MW Retrieval			First Retrieval			Final Retrieval		
	mean	nn	bias	rms	nn	bias	rms	nn	bias	rms	nn
T_surf	274.049	471	0.586	2.442	471	0.019	0.561	471	-0.035	0.298	471
618.- 684.	265.618	442	-0.759	1.784	442	0.250	0.984	442	0.188	0.705	442
684.- 778.	272.927	393	-0.648	1.783	393	0.173	1.004	393	0.149	0.666	393
778.- 879.	279.234	370	0.003	2.041	371	-0.104	1.242	371	-0.139	0.922	371
879.-1100.	283.436	315	1.512	2.994	317	-0.178	1.044	317	-0.130	0.885	317
103.-1100.	troposphere		-0.164	1.658		-0.026	0.828		0.085	0.651	
T_total			0.777	2.061		0.018	0.811		0.043	0.669	

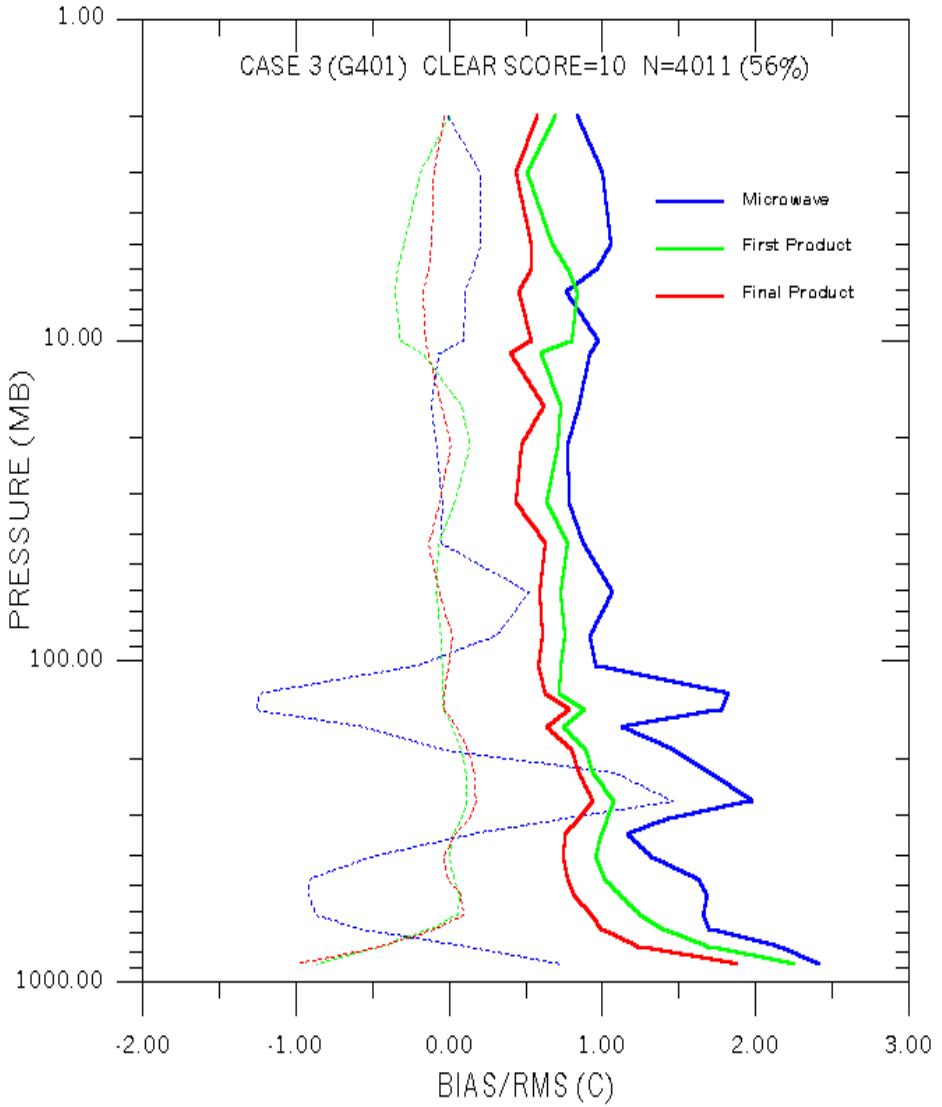
Case 3 Results -- Cloud Clearing Score 1.5 vs. No Score threshold



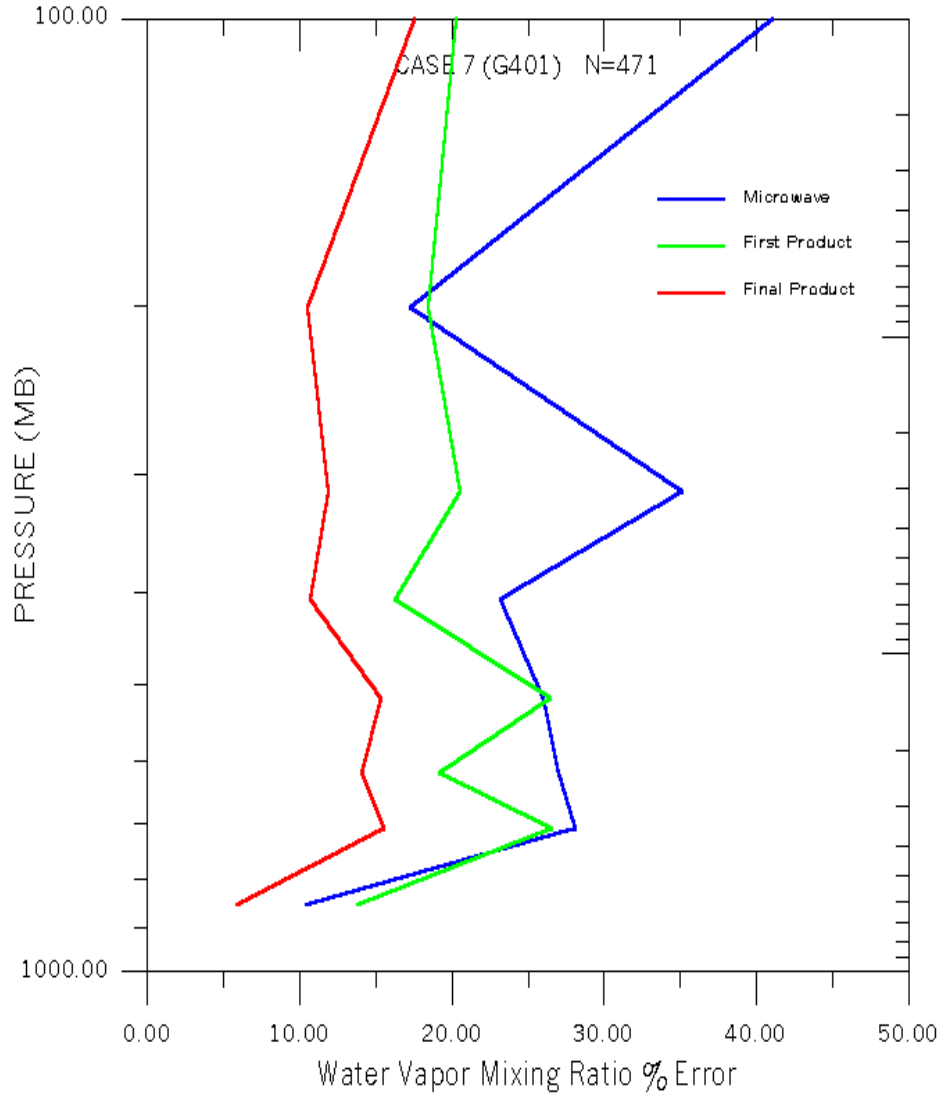


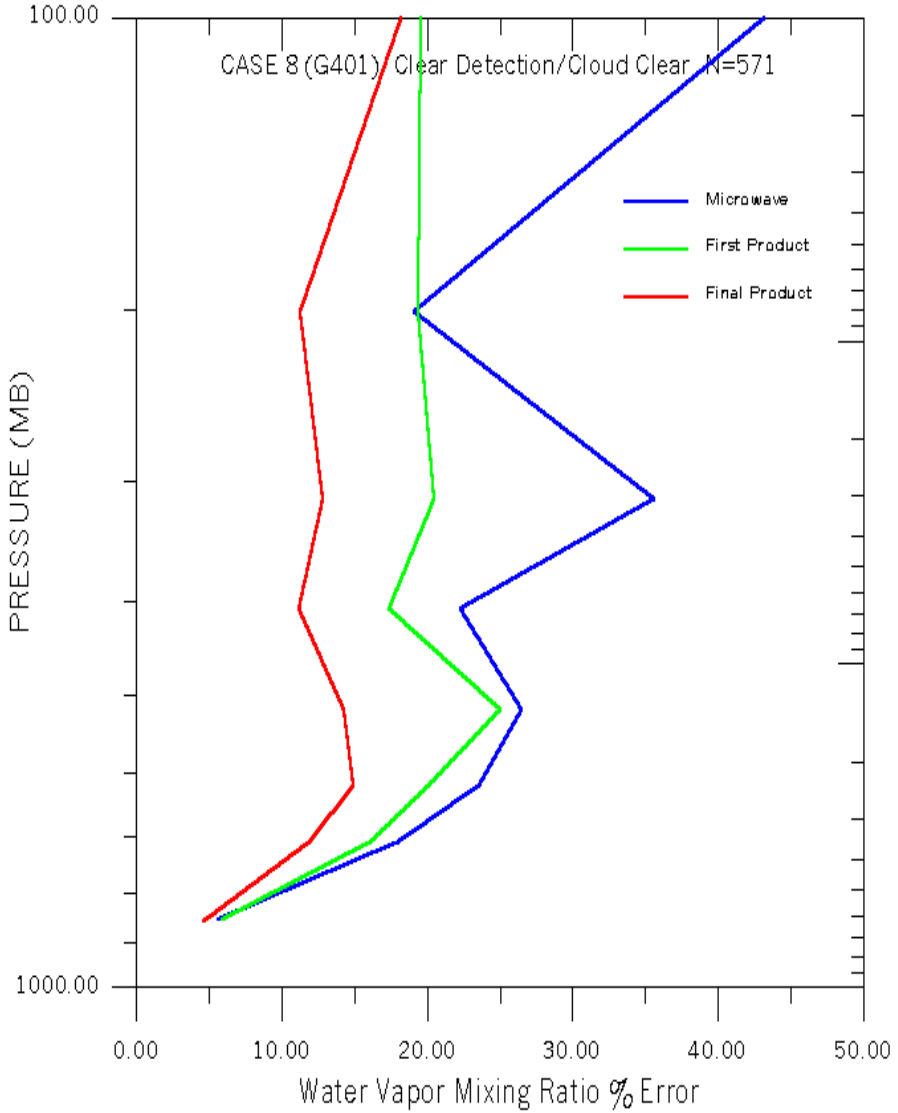
Case 8 vs. Case 3 (no score)



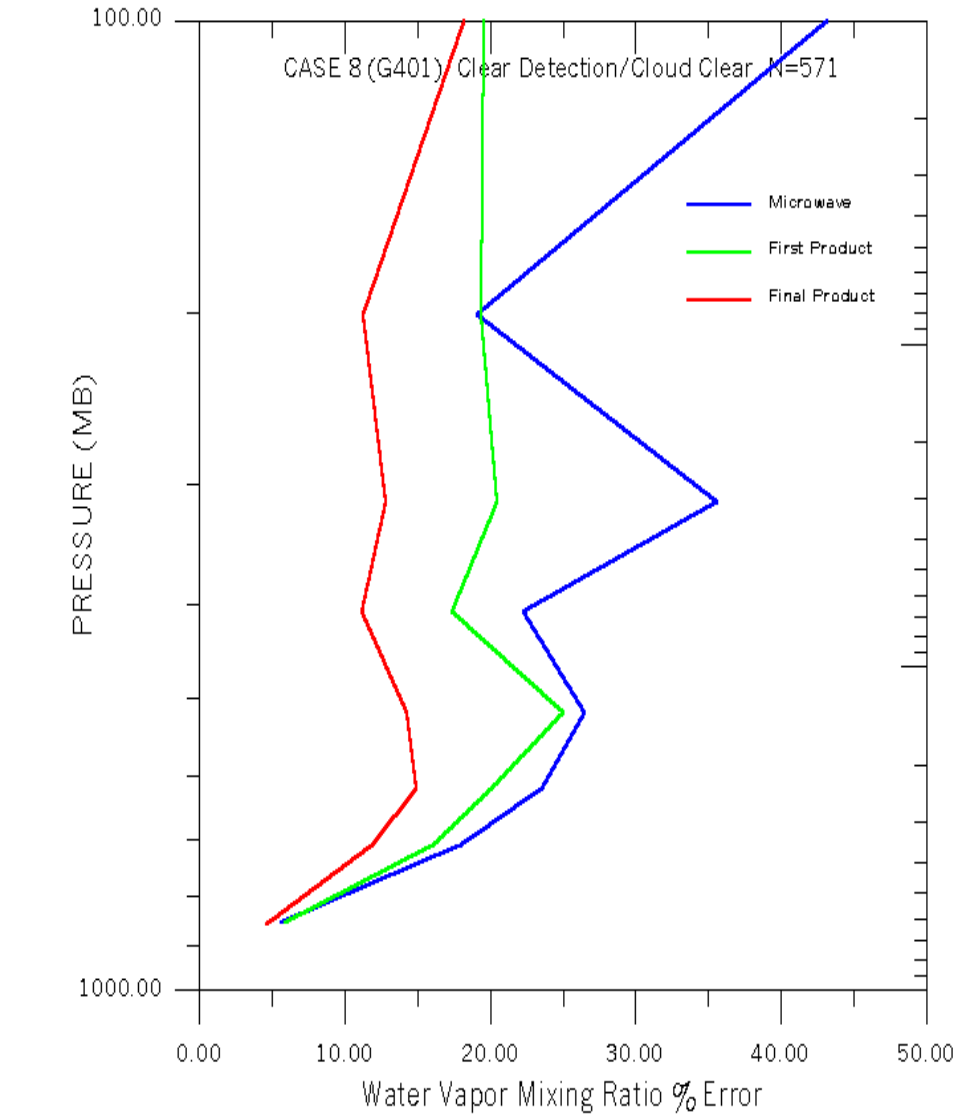


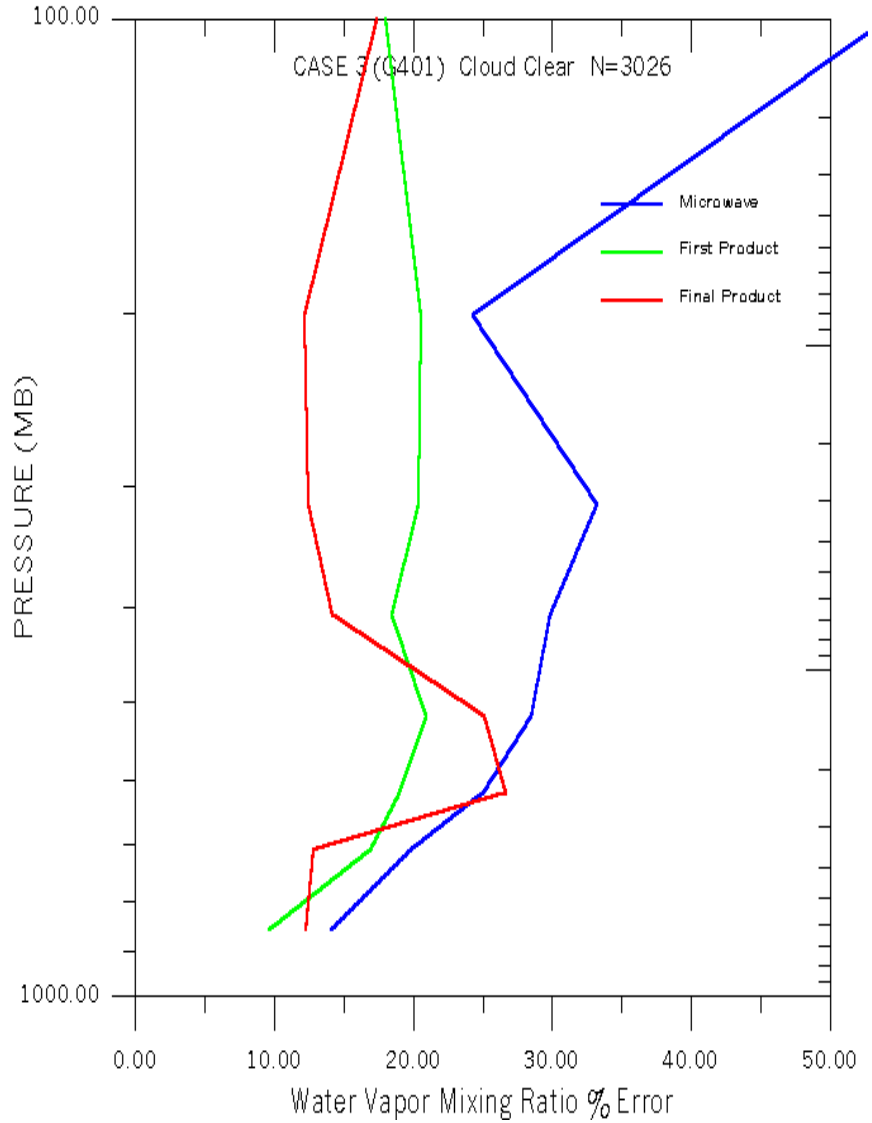
MOISTURE ---True Clear vs. Clear Detection



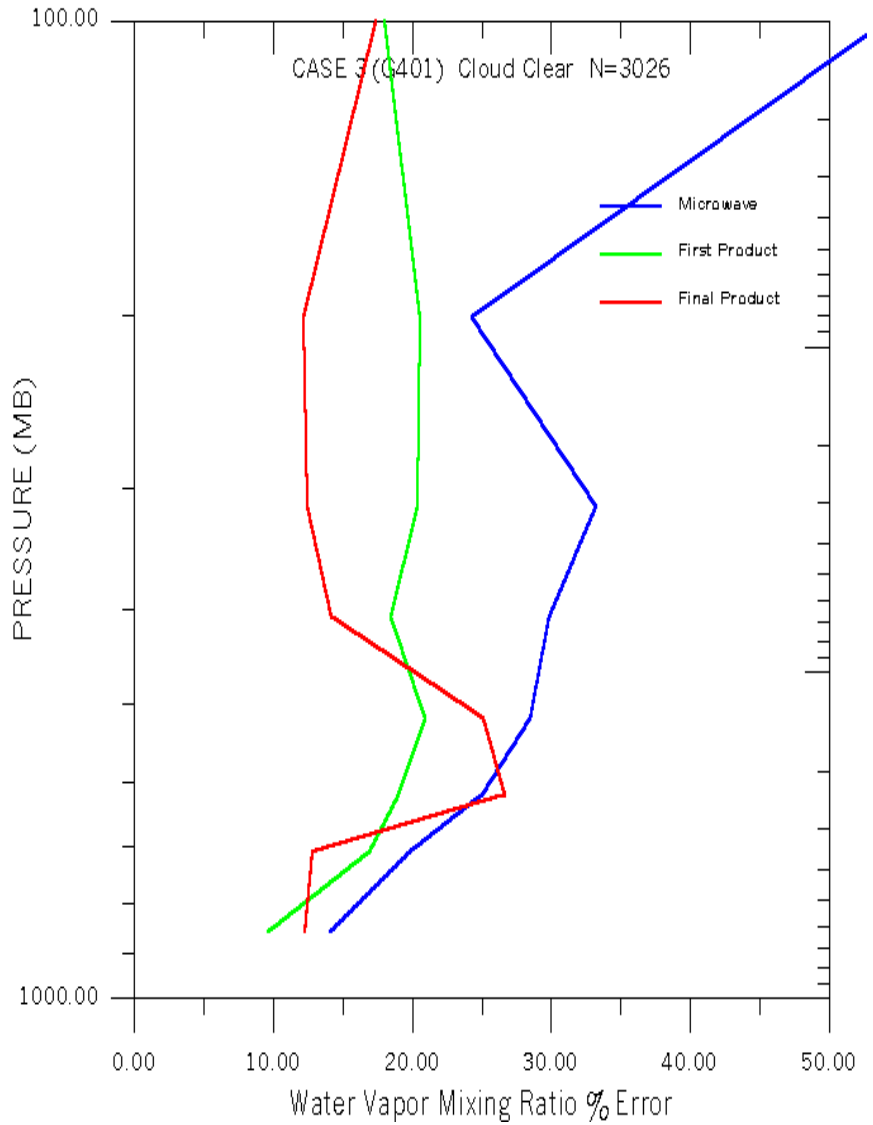


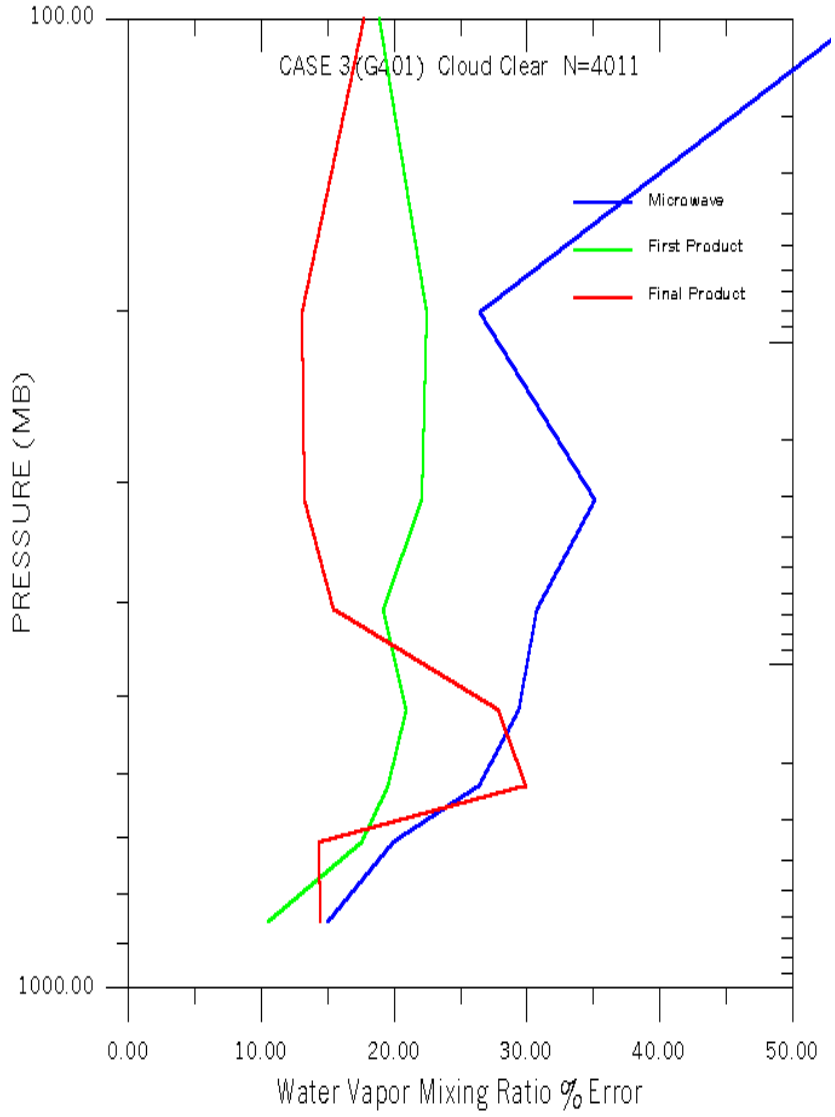
Clear Detection vs. Cloud Clear Score 1.5





Cloud Clear score 1.5 vs CC no score





Summary

- Clear test selects the best retrievals with good global distribution
- Generate clear radiances from forecast and compare with measured as an additional test (need few channels)
- Add cloud amount and height retrieval outside of PGE for NWP users
- Generate regression for all cases - provide level indicator to specify where regression profile can be used.
- Above implies hybrid first guess with microwave-only retrieval