AIRS Clear Detection

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Objectives

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

Detecting clear fovs using AMSU

- AMSU channels 4, 5 and 6 are used to predict AIRS channel at 2390.910 cm-1.

  Predicted AIRS at 2390.910 = 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
- Split IR window test is also used as secondary test.
- Spatial and spectral coherence tests are needed to remove misclassified fovs. Most misclassified fovs have low clouds
- But for most cases, the AMSU test works quite well.

AIRS 2390.91 Weighting functions
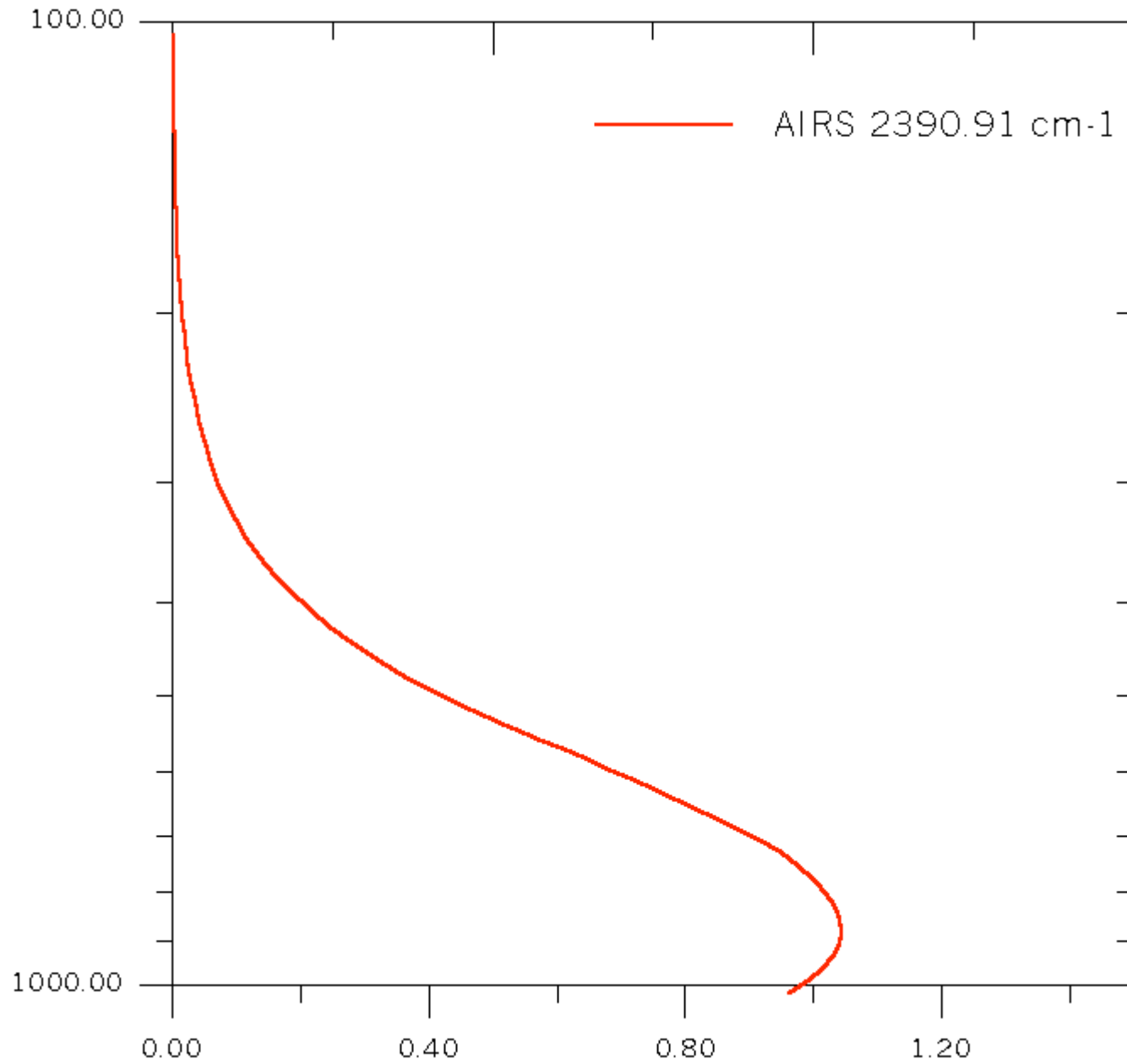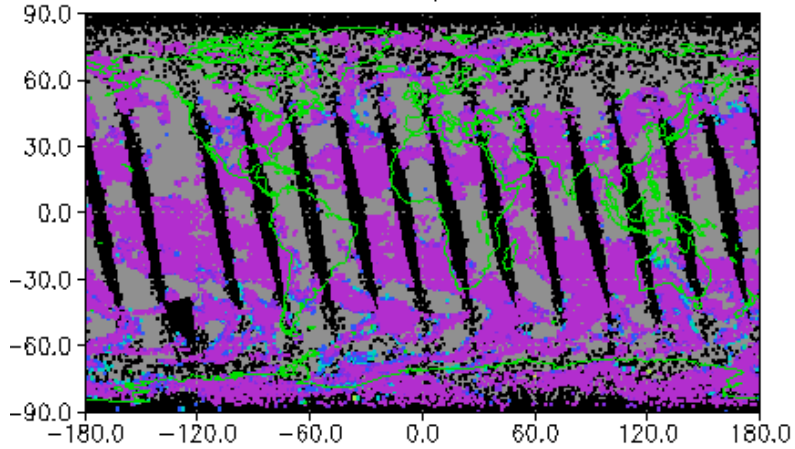
Predict AIRS from AMSU test
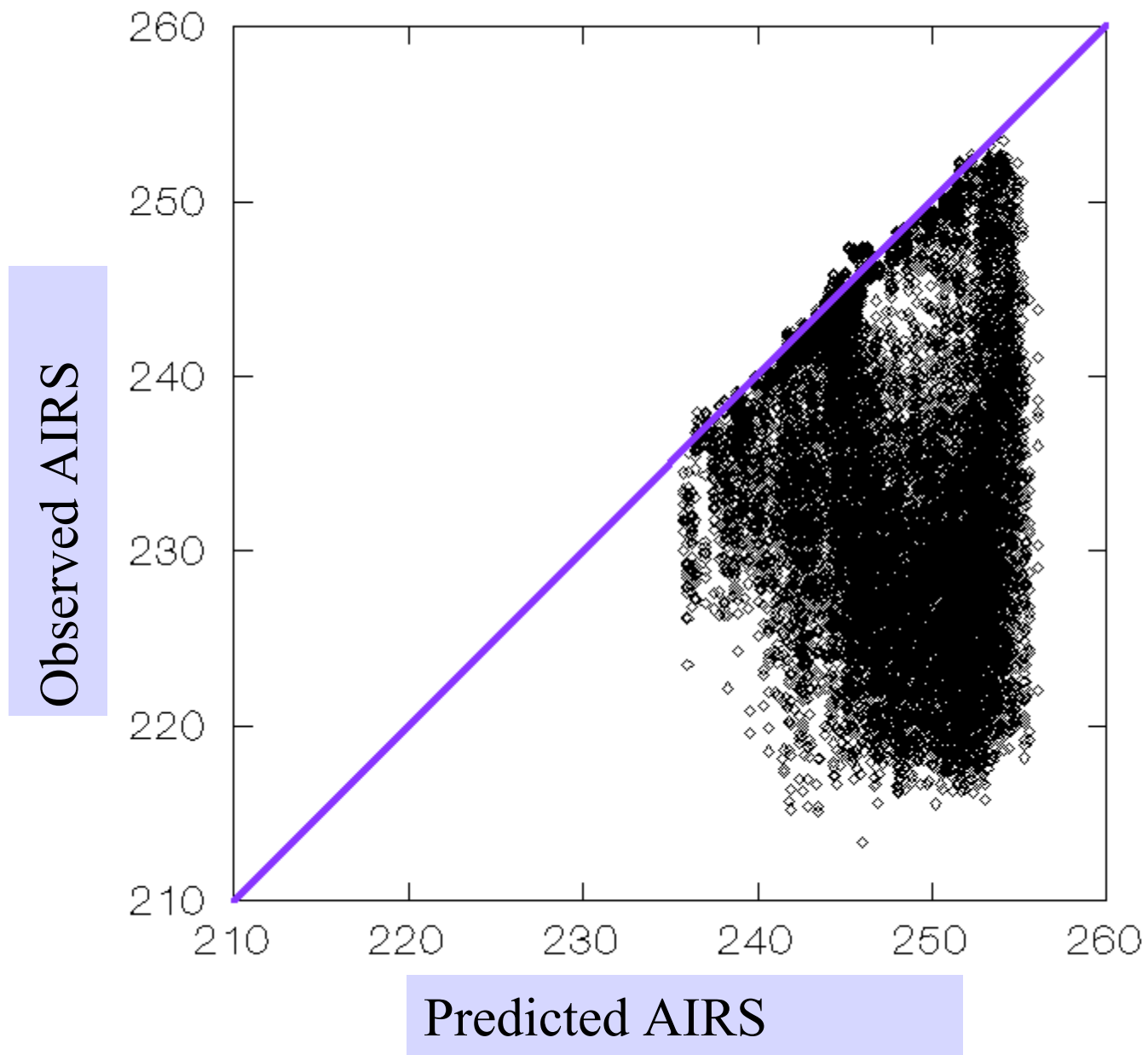
Improvements to clear detection

- Add reconstruction score (< 0.98)

- Add spatial coherence test – compute standard deviation of 2390.91 cm-1 within 3x3

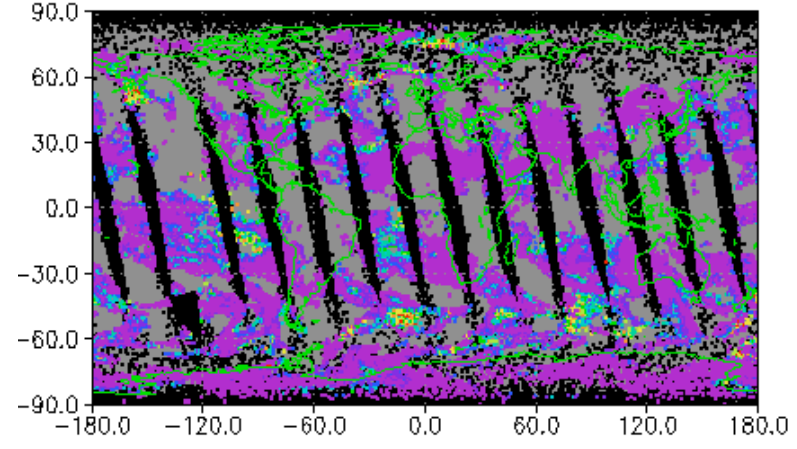- Instrumental noise is very low (.10 K)

AMSU test only ; diff < 2

Nov. 29 2000, amt1

Ascending bias=0,rms=0,sample=18081 (36.5%)
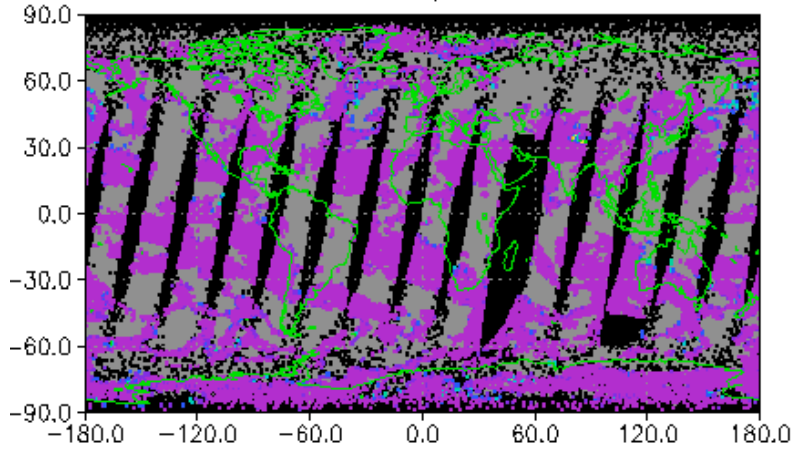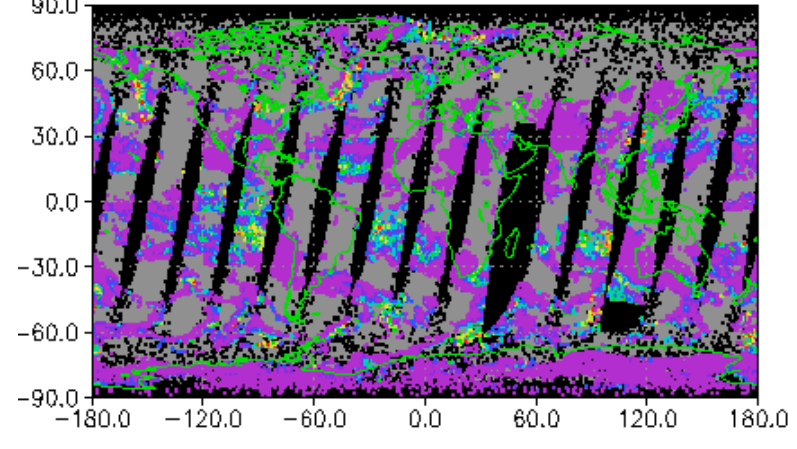True mean=0.0292679,True std=0.0534177

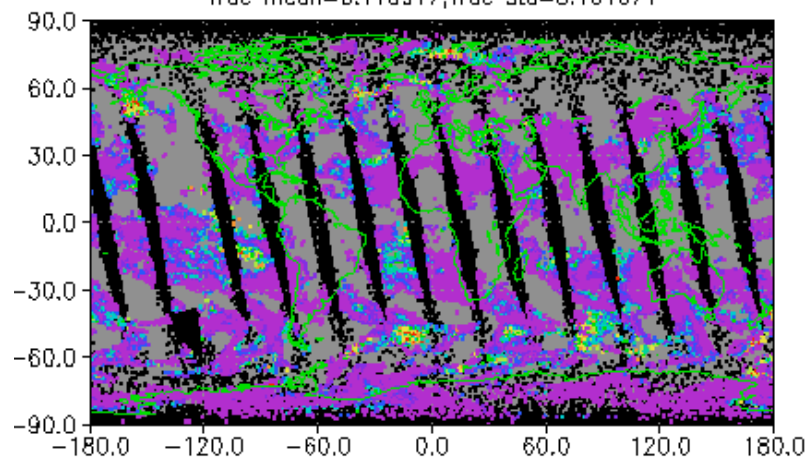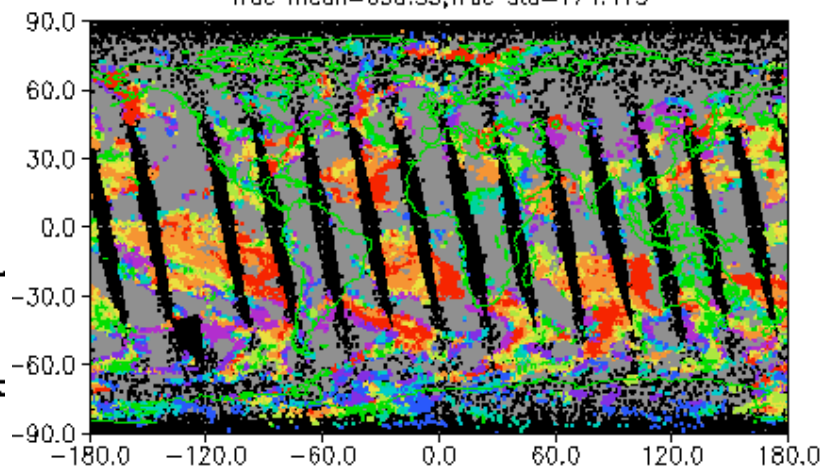Descending bias=0,rms=0,sample=16762 (34.8%)
True mean=0.0202745,True std=0.0400008

Nov. 29 2000, amt2

Ascending bias=0,rms=0,sample=18081 (36.5%)
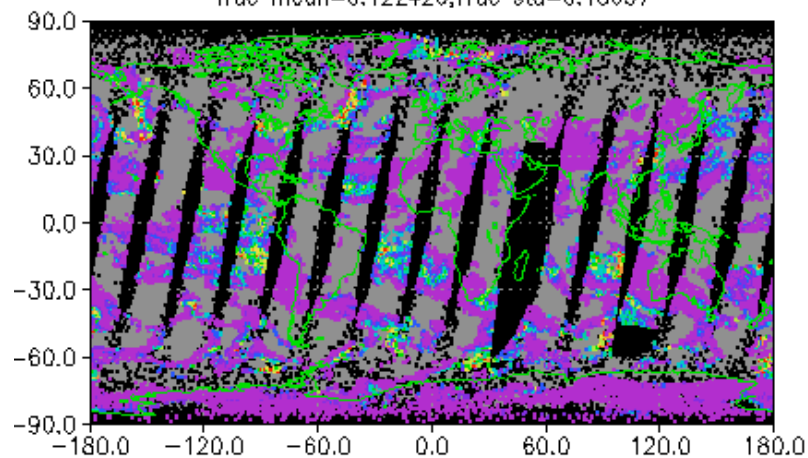True mean=0.110917,True std=0.161674

Descending bias=0,rms=0,sample=16762 (34.8%)
True mean=0.122426,True std=0.18037

Nov. 29 2000, amt2

Ascending bias=0,rms=0,sample=18081 (36.5%)
True mean=0.110917,True std=0.161674

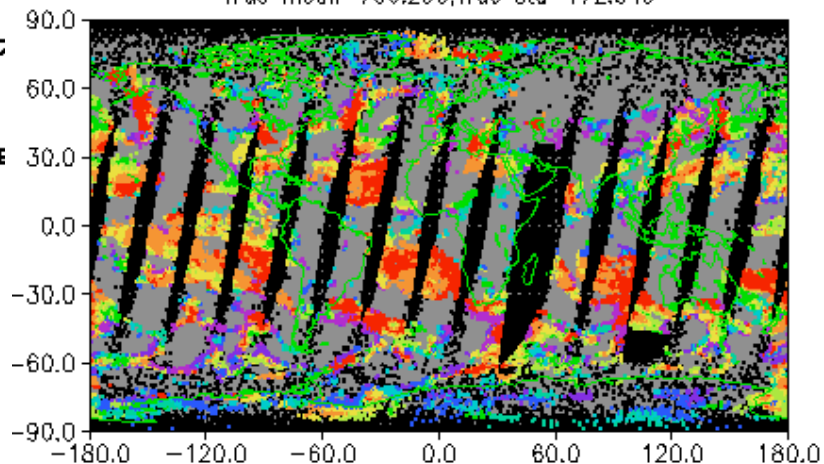Descending bias=0,rms=0,sample=16762 (34.8%)
True mean=0.122426,True std=0.18037

Nov. 29 2000, pcld2

Ascending bias=0,rms=0,sample=14918 (30.1%)
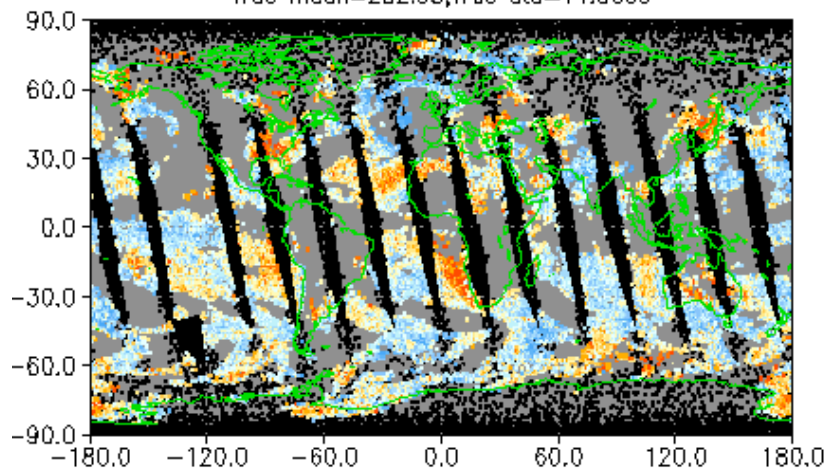True mean=690.35,True std=174.413

Descending bias=0,rms=0,sample=13214 (27.4%)
True mean=706.256,True std=172.349
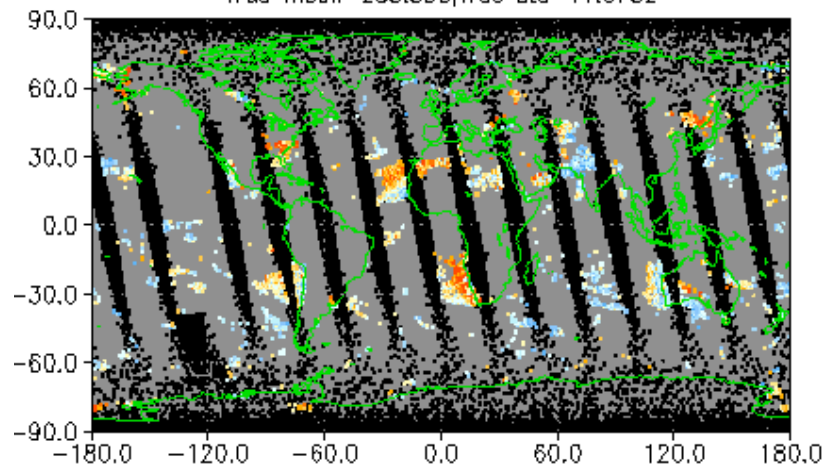
Regression retrieval is insensitive to low clouds

Nov. 29 2000, Temperature Error (904.8660 to 1013.948mb)
Ascending bias=−0.206719,rms=1.24611, sample=14576(34.3%)
True mean=282.95,True std=11.0669

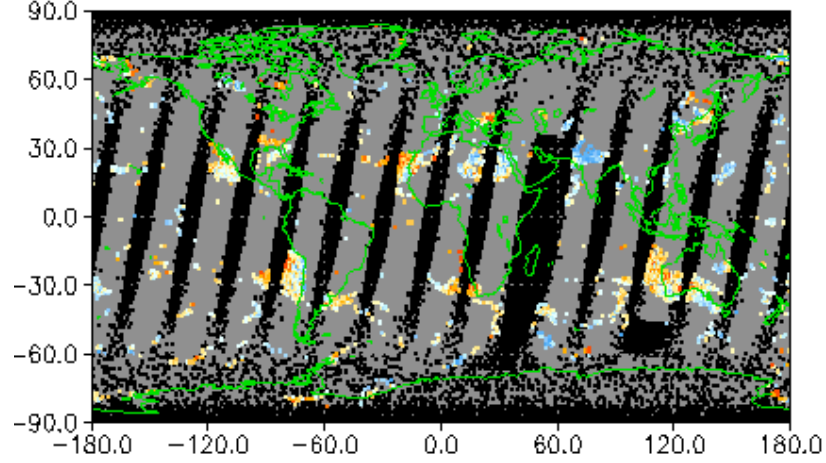Nov. 29 2000, Temperature Error (904.8660 to 1013.948mb)
Ascending bias=0.0321952,rms=1.29576, sample=2510(5.9%)
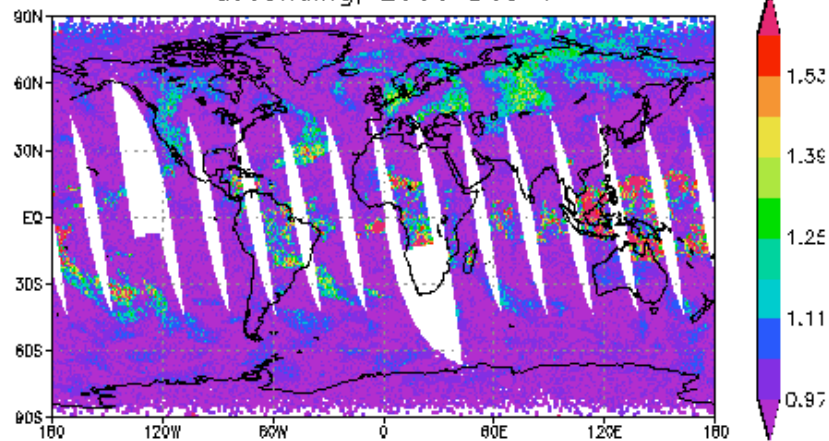True mean=285.836,True std=11.0782

Descending bias=−0.20465,rms=1.25579,sample=12930 (31.5%)
True mean=282.651,True std=10.8423
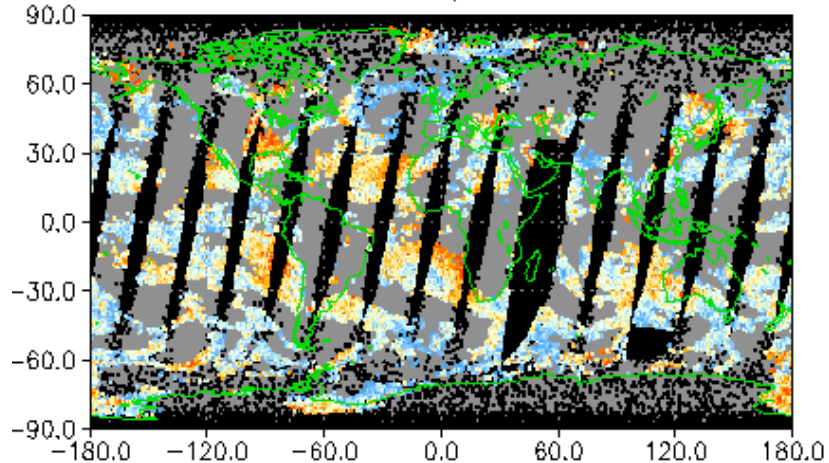
Descending bias=0.101004,rms=1.21595,sample=2442 (5.9%)
True mean=284.372,True std=10.88

score Ch-1
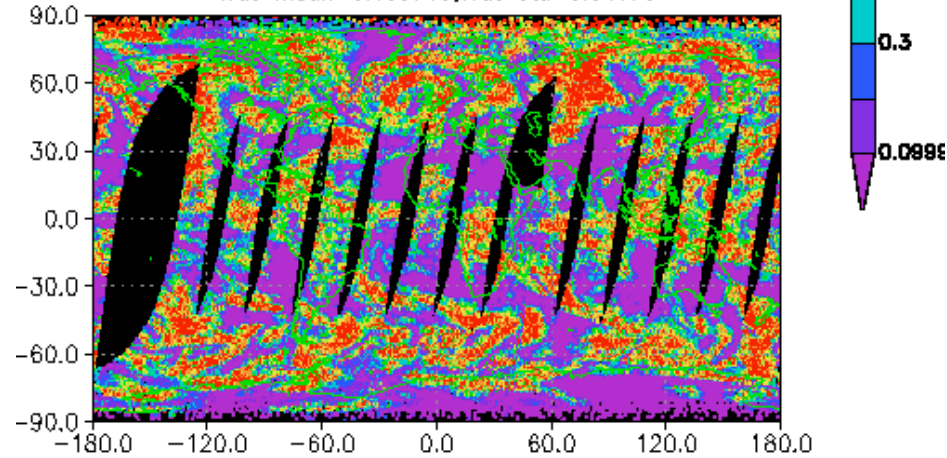ascending, 2000 Dec 1

Dec. 1 2000, totcld

Ascending bias=0,rms=0,sample=47505 (100.%)
True mean=0.448065,True std=0.338208
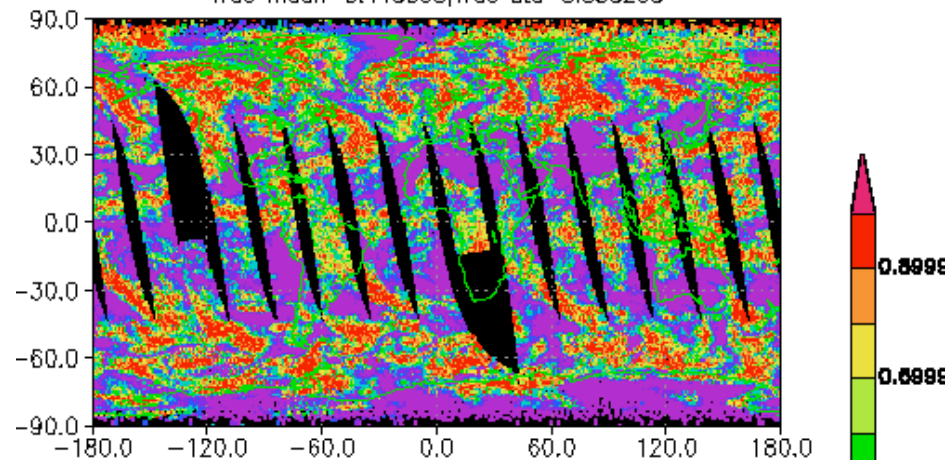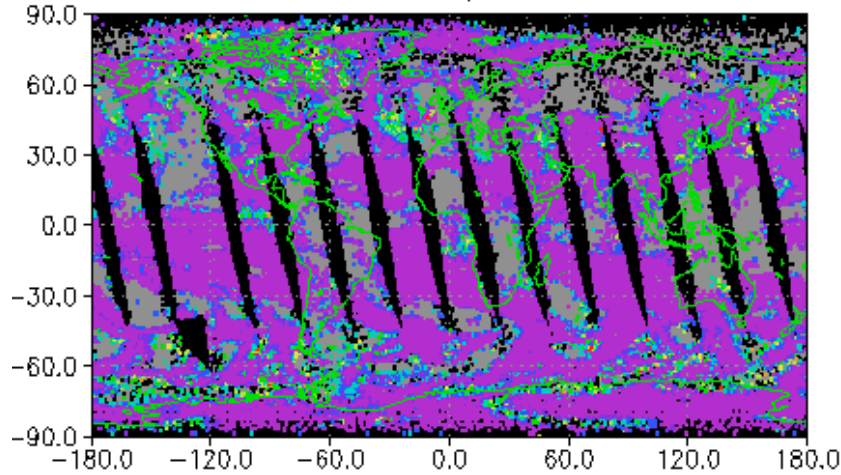
score Ch-1
descending, 2000 Dec 1
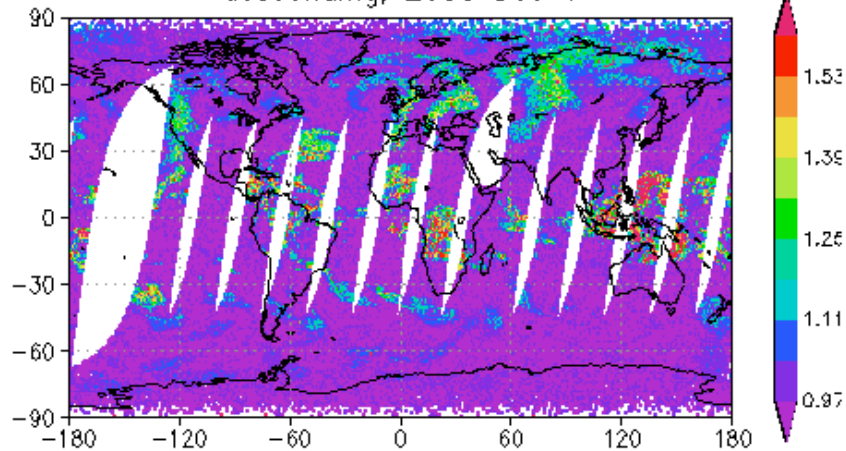
Descending bias=0,rms=0,sample=46286 (100.%)
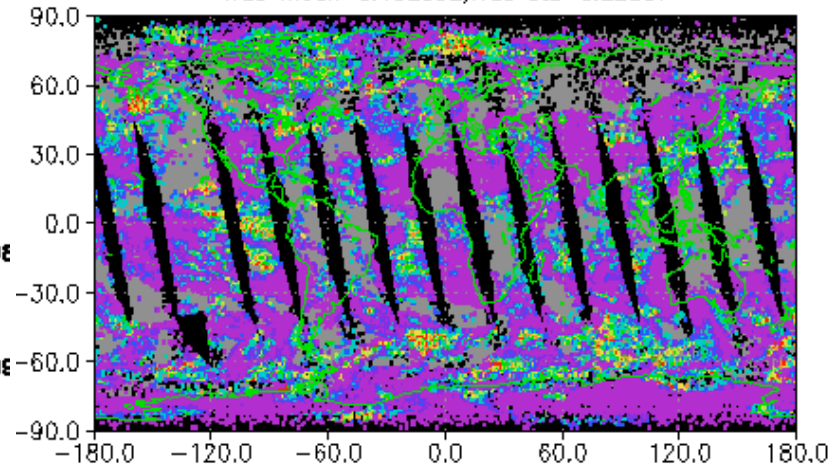True mean=0.453765,True std=0.34179

Reconstruction score < 0.98
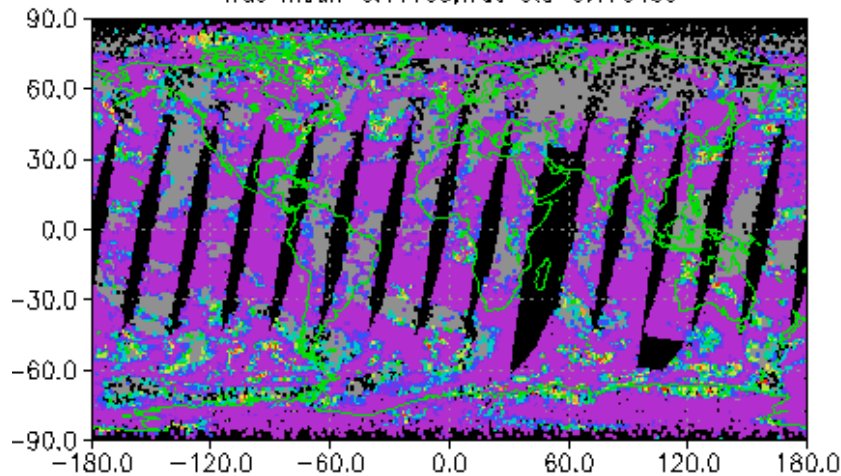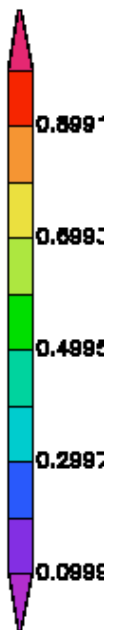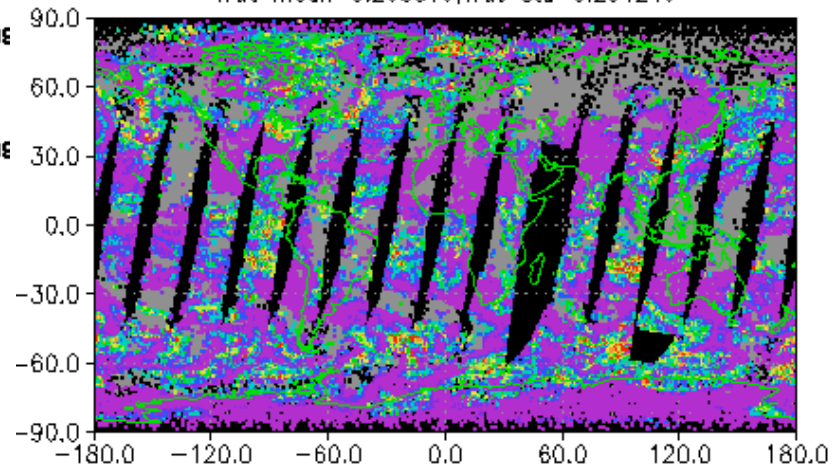
Spatial coherence < 0.0018

Nov. 29 2000, amt1

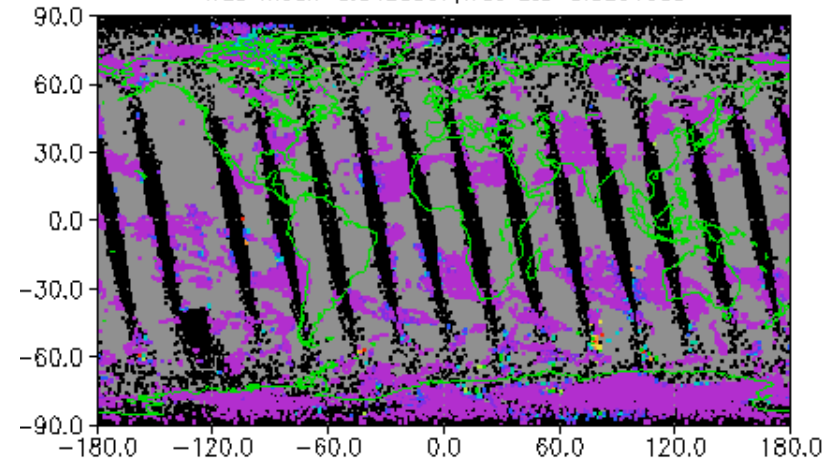Ascending bias=0,rms=0,sample=10044 (20.2%)
True mean=0.0286951,True std=0.0859487

Descending bias=0,rms=0,sample=8717 (18.1%)
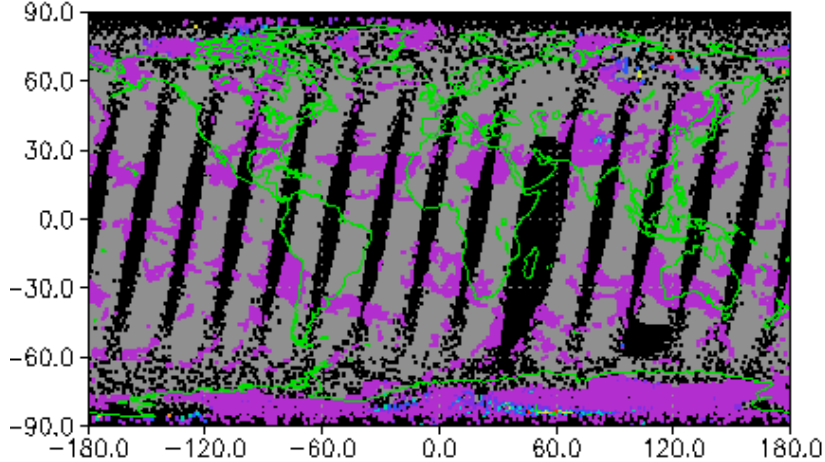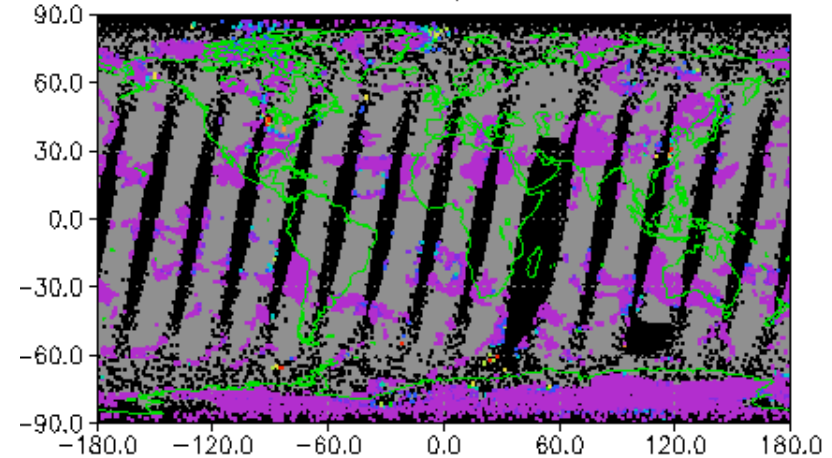True mean=0.0201686,True std=0.0629949
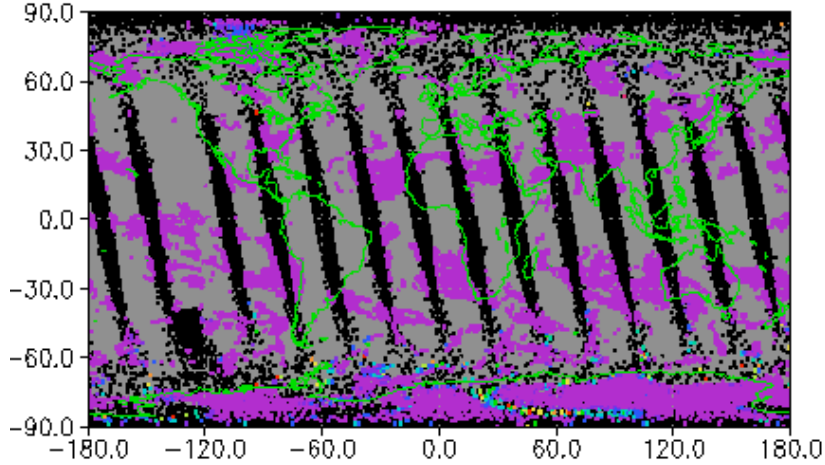
Nov. 29 2000, amt2

Ascending bias=0,rms=0,sample=10044 (20.2%)
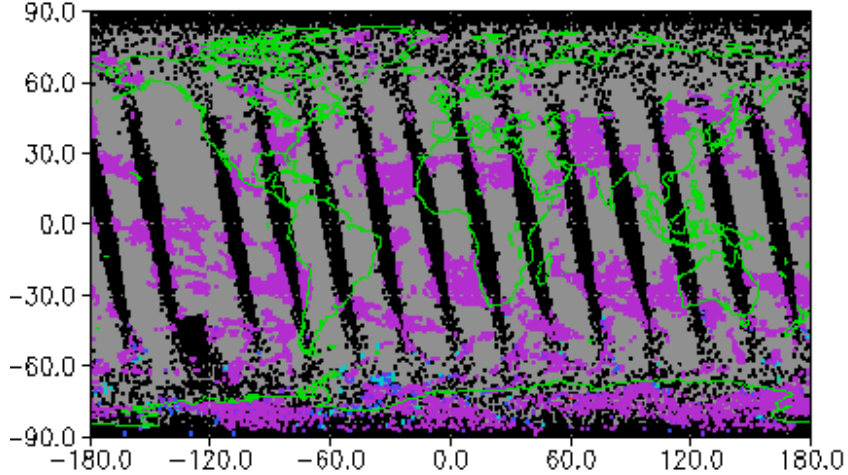True mean=0.0420067,True std=0.0891638

Descending bias=0,rms=0,sample=8717 (18.1%)
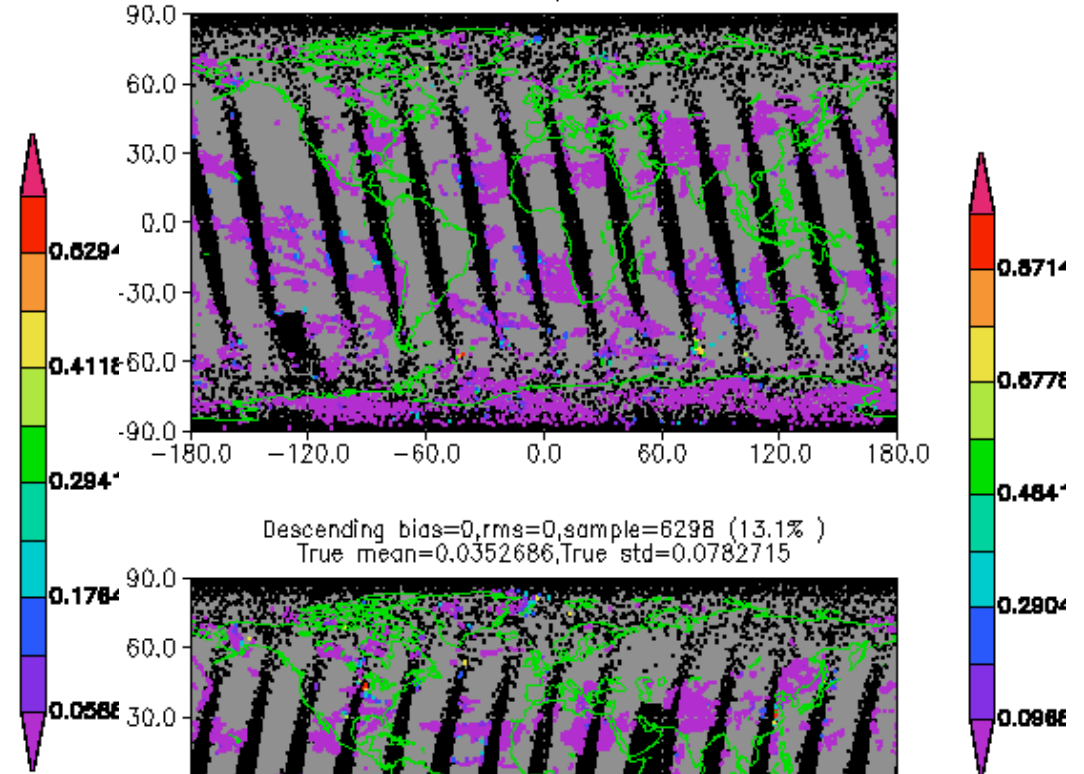True mean=0.0397459,True std=0.0881157

All three tests

Nov. 29 2000, amt1
Ascending bias=0,rms=0,sample=6907 (13.9%)
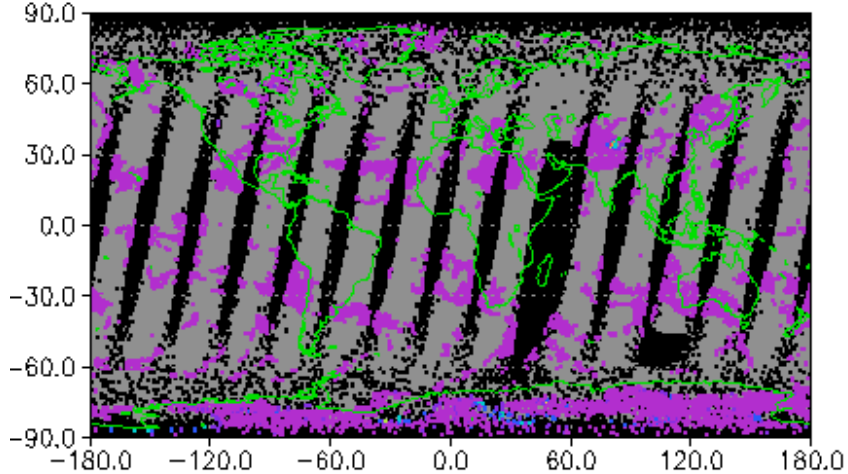True mean=0.0121996,True std=0.0315898
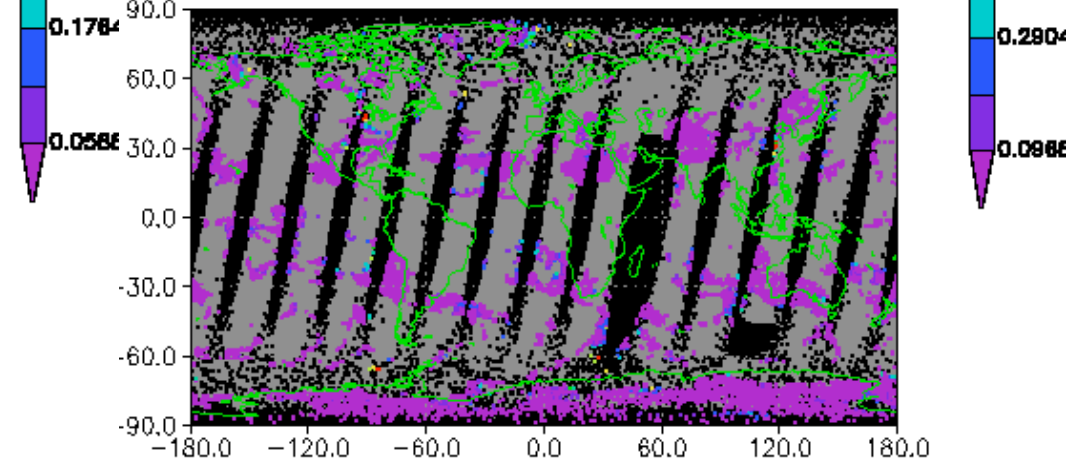
Nov. 29 2000, amt2
Ascending bias=0,rms=0,sample=6907 (13.9%)
True mean=0.0354499,True std=0.0686763

Descending bias=0,rms=0,sample=6298 (13.1%)
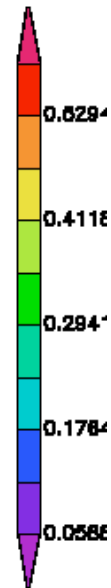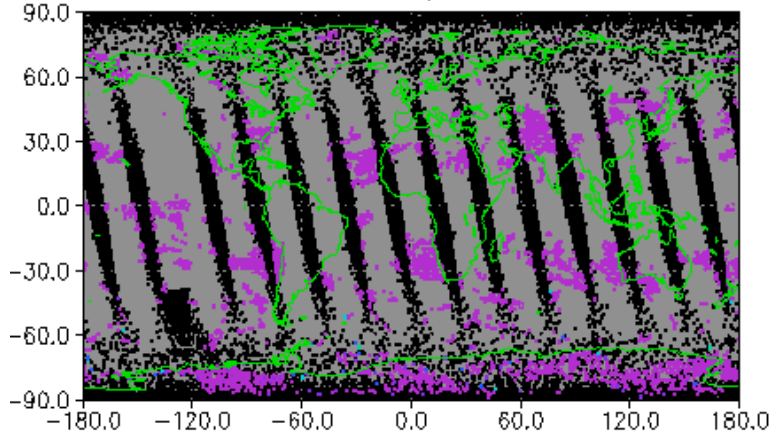True mean=0.00865444,True std=0.027224

Descending bias=0,rms=0,sample=6298 (13.1%)
True mean=0.0352686,True std=0.0782715
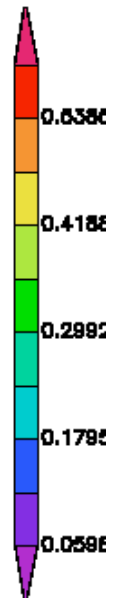
All 3 tests, but coherence < 0.0009
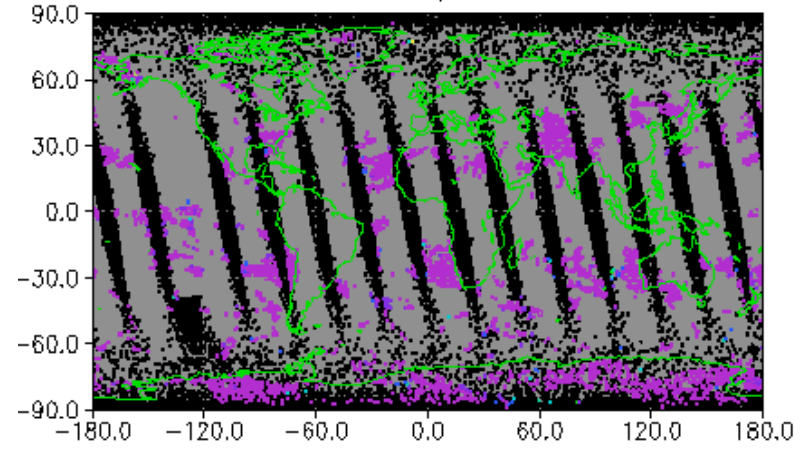

Nov. 29 2000, amt1

Ascending bias=0,rms=0,sample=3303 (6.6%)
True mean=0.00703487,True std=0.0214925

Descending bias=0,rms=0,sample=3220 (6.6%)
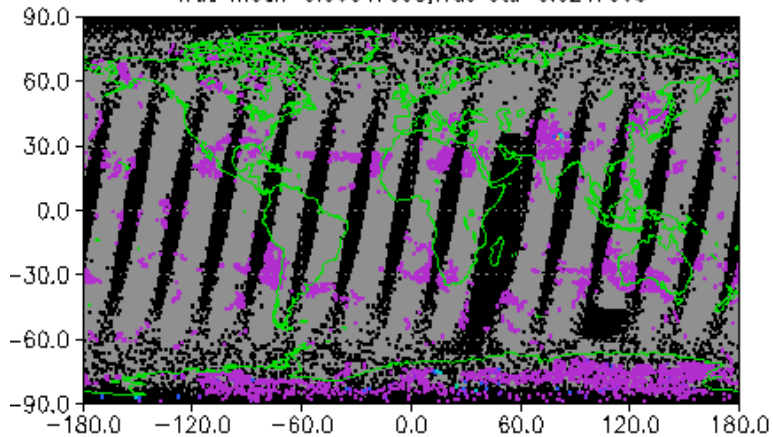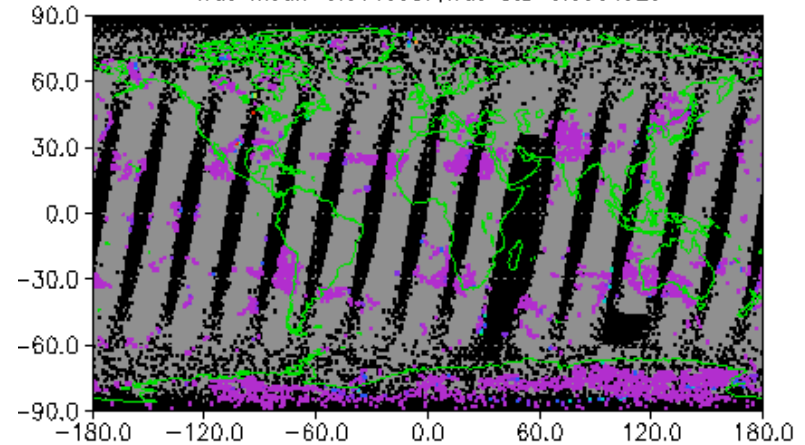True mean=0.00647008,True std=0.0247368

Nov. 29 2000, amt2

Ascending bias=0,rms=0,sample=3303 (6.6%)
True mean=0.0140253,True std=0.0328653

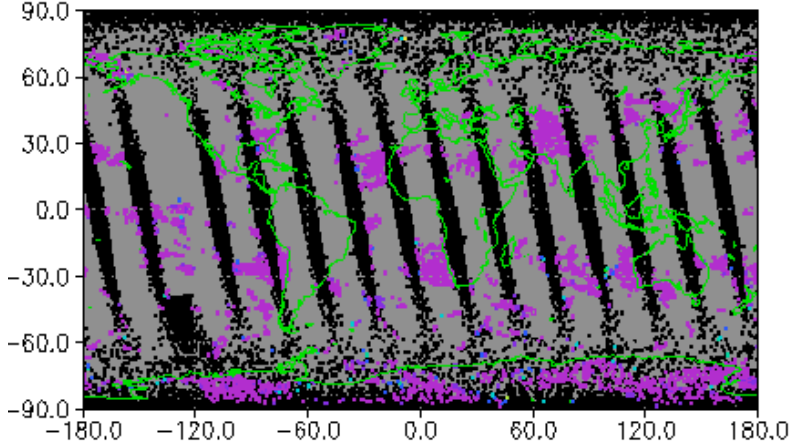Descending bias=0,rms=0,sample=3220 (6.6%)
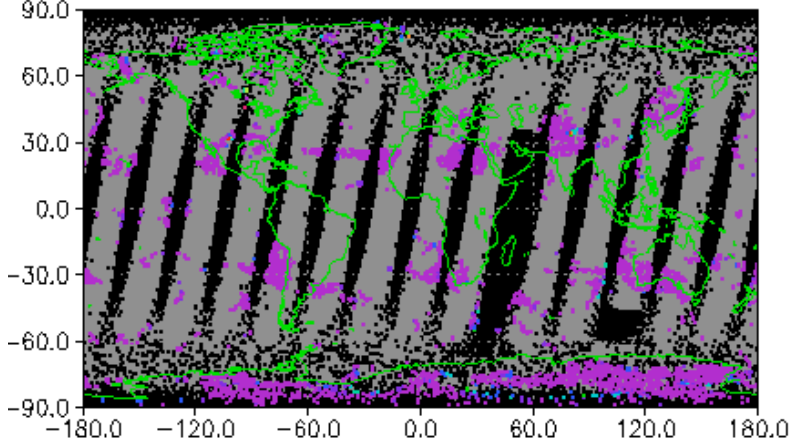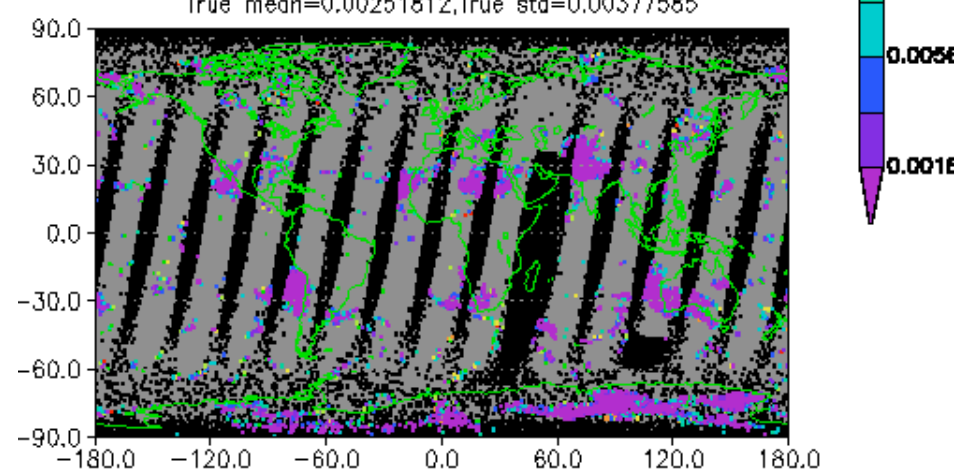True mean=0.0148387,True std=0.0384928

Total cloud (3 tests)

True clear (< .02%)
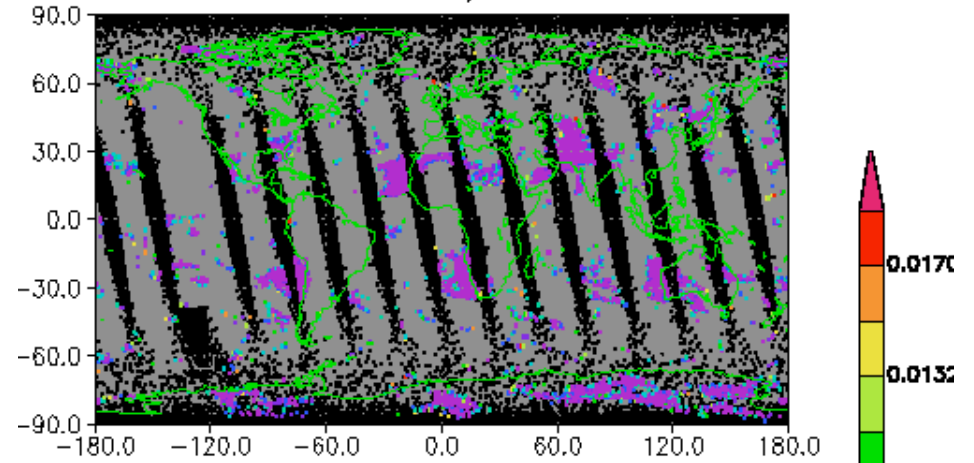
Rscore < 0.98

Temperature at layer 14.45600 to 29.12100 mb
ascending, 2000 Nov 29
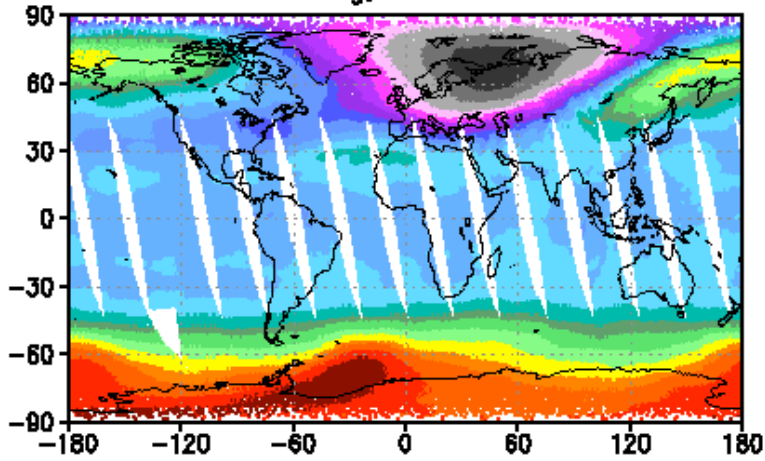
decending, 2000 Nov 29

Nov. 29 2000, Temperature Error (14.45600 to 29.12100mb)

Ascending bias=−0.0598708,rms=0.641739, sample=28374(57.4%)
True mean=223.646,True std=10.8011

Descending bias=0.0349081,rms=0.633401,sample=28819 (60.0%)
True mean=223.8,True std=10.6053

Rscore < 1.25

Nov. 29 2000, totcld

Ascending bias=0,rms=0,sample=49509 (100.%)
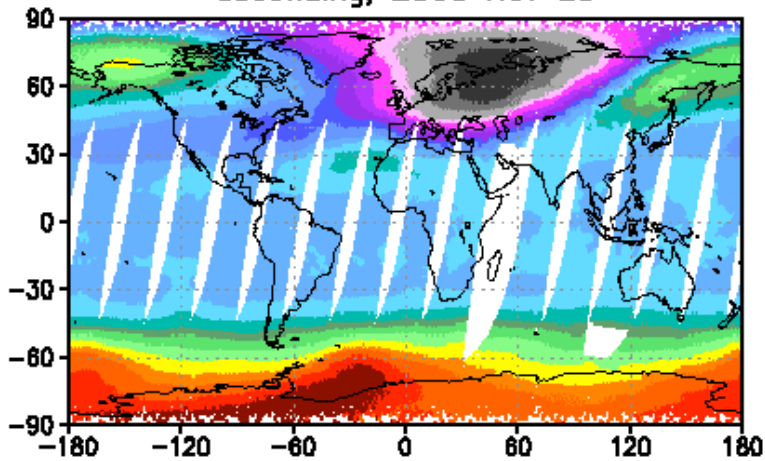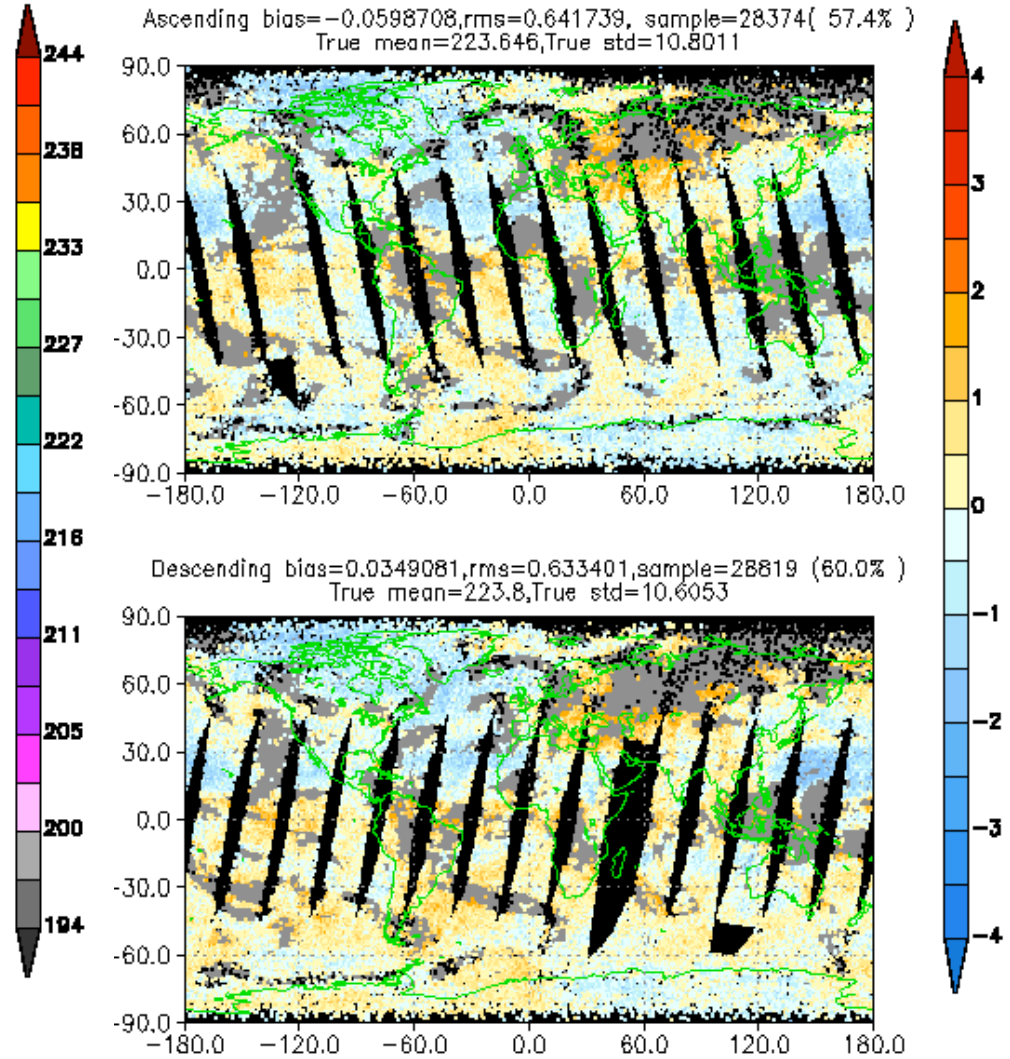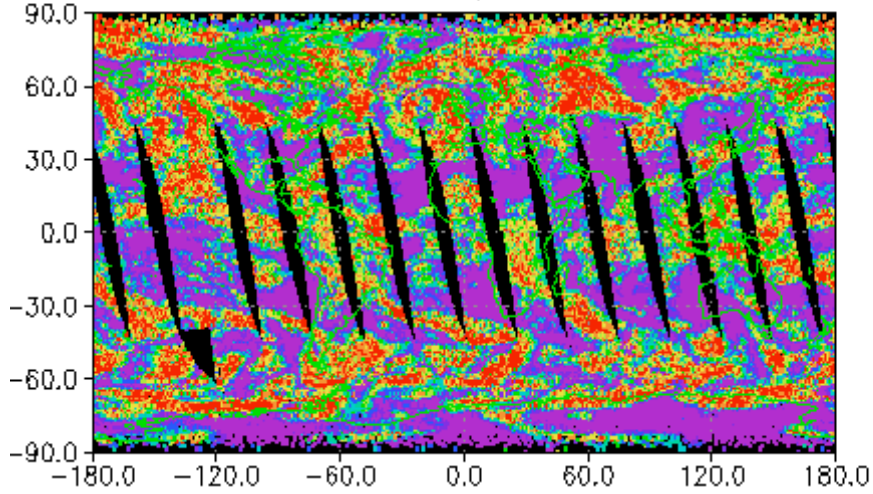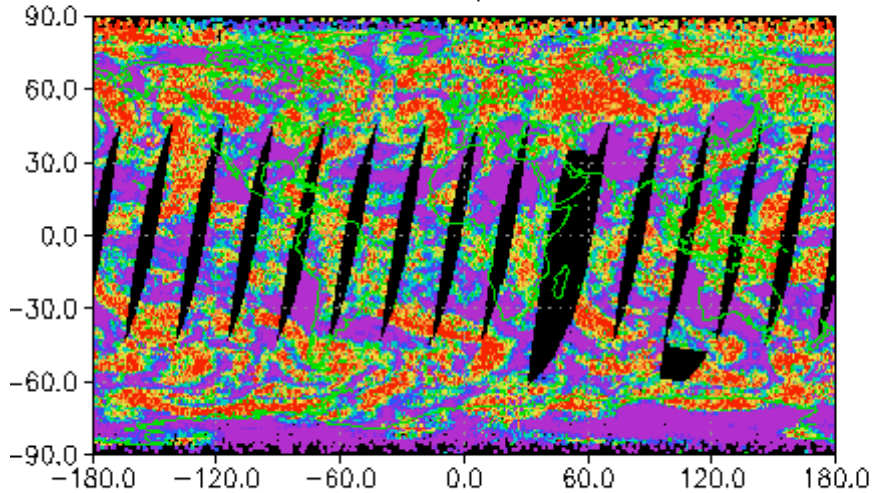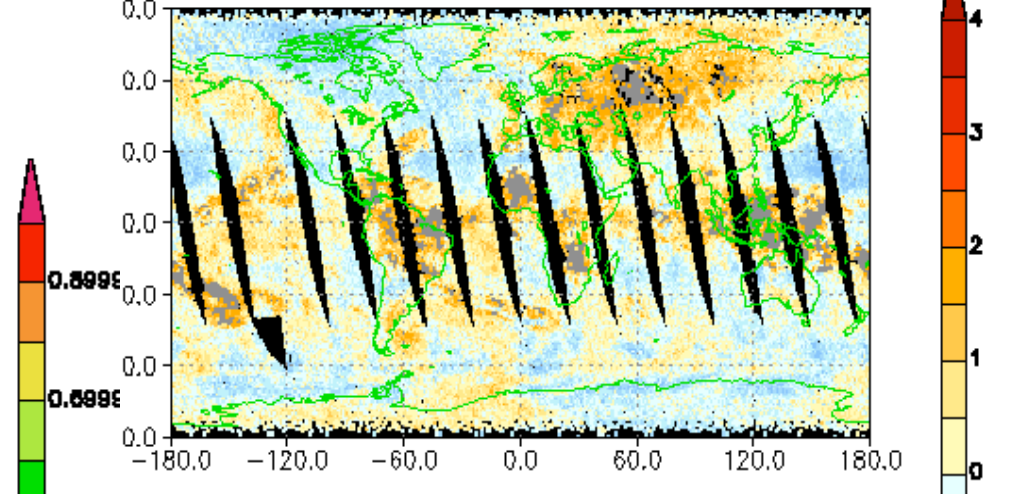True mean=0.448043,True std=0.338089

Descending bias=0,rms=0,sample=48068 (100.%)
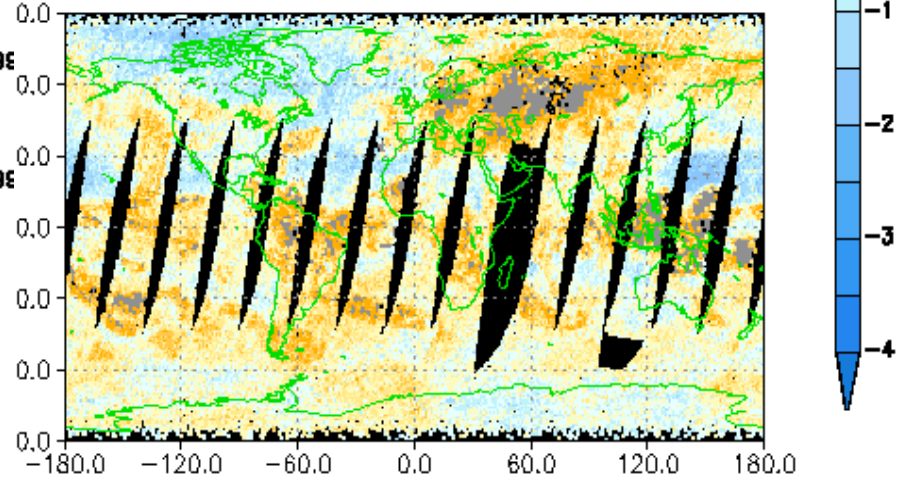True mean=0.457328,True std=0.339257

Nov. 29 2000, Temperature Error (14.45600 to 29.12100mb)

Ascending bias=0.0227724,rms=0.739809, sample=45243(91.6%)
True mean=222.452,True std=11.2928

Descending bias=0.194737,rms=0.75757,sample=43616 (90.8%)
True mean=222.293,True std=11.1709

Summary

- Continue to improve cloud detection
- Add cloud amount and height retrieval outside of PGE for NWP users
- Generate clear radiances from forecast and compare with measured as an additional test (need few channels)